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With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CLIV.—No. 4003] LONDON: FRIDAY EVENING, SEPTEMBER 30, 1932 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

SPRINKLER AND HEATING SYSTEMS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 19th October, 1932, for the INSTALLATION of—(1) An AUTOMATIC SPRINKLER (Wet Pipe) SYSTEM at the Letter Office, E.C.

(2) HEATING, &c., at the Royal Air Force College, Cranwell, Lincs.

Drawings, specifications, copies of the conditions and forms of contract, bills of quantities, and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. OFFICE OF WORKS, King Charles-street, London, S.W.1, on payment of One Pound in each case. (Cheques payable to The Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 9005

Civil Service Commission.

FORTHCOMING EXAMINATION.—PROBATIONARY INSPECTORS (Male) in the Engineering Department of the Post Office (17-23, with extension for service in H.M. Forces).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W.1, giving THE TITLE OF THE SITUATION. The latest date for the receipt of application forms is 27th October, 1932. 8912

University College of South Wales and Monmouthshire.

COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.

A SPECIAL CLASS in METALLOGRAPHY, suitable for persons engaged in Metallurgy, Mining, and Engineering, will be HELD on SATURDAY MORNING, at the UNIVERSITY COLLEGE, Newport-road, Cardiff.

The Class will commence on OCTOBER 8th, 1932. Particulars may be obtained from the undersigned.

D. J. A. BROWN, Registrar.

University College,
Cathays Park,
Cardiff. 9003

Abingdon Corporation.

WATERWORKS.
CONTRACT NO. 2.

The Council of the Borough of Abingdon invite TENDERS for the CONSTRUCTION of a 99,000-Gallon REINFORCED CONCRETE RESERVOIR and APPURTENANCES, a 9in. PIPE LINE, COMPLETION of ONE INTAKE WELL, ERECTION of PUMP HOUSE, and other WORKS incidental to the above, in accordance with the drawings and specification prepared by the Consulting Engineer, Mr. T. W. Ellis, M.I. Mech. E., M.I.E.E., in collaboration with Mr. A. P. I. Cotterell, M. Inst. C.E.

Drawings and specification may be seen at the offices of the Engineers, 70 and 54, Victoria-street, Westminster, S.W.1; or at the office of the Borough Engineer, the Abbey House, Abingdon, during the usual office hours, on or after the 12th October, 1932, and copies of the bills of quantities and form of Tender may be obtained from the Consulting Engineer, on payment of the sum of Five Guineas, which will be returned on receipt of a bona fide Tender and all other documents supplied.

Tenders, on the form provided, enclosed in sealed envelopes, must be delivered to the undersigned and endorsed "Waterworks, Contract No. 2," not later than 10 a.m. on the 24th October, 1932.

The Council do not undertake to accept the lowest or any Tender.

W. CARLYLE CROASDELL,
Town Clerk.

The Abbey House, Abingdon, Berks.,
28th September, 1932. 9015

Epsom Urban District Council.

WATER DEPARTMENT.
ADDITIONAL PUMPING PLANT.

The Epsom Urban District Council Invite TENDERS from British Manufacturers for the SUPPLY and ERECTION of PUMPING PLANT, comprising Two Electrically Driven Bore-hole Pumps and One Electrically Driven High-lift Pump.

Plans, specification, and form of Tender may be obtained from Mr. T. N. Young, Engineer-Manager, Water Department Offices, East-street, Epsom.

Sealed Tenders, endorsed "Tender for Pumping Plant," must be delivered to my office not later than Noon on Monday, 24th October, 1932.

The Council do not bind themselves to accept the lowest or any Tender.

P. E. WHITEOAK-COOPER,
Clerk and Solicitor.

49, Church-street,
Epsom, Surrey. 9016

Fulham Borough Council.

GENERATING STATION EXTENSIONS.

The Fulham Borough Council is prepared to receive TENDERS for the following ENGINEERING WORKS in connection with the Extension of the Council's Generating Station in Townmead-road, Fulham, viz.:—

SECTION "D."—CONDENSING PLANT.—The Manufacture, Delivery, Erection, and Maintenance of Two Surface Condensers, each having an area of 54,000 sq. ft., and each complete with Circulating Water Pumps and Motors, Pipe Work, Condensate Extraction Pumps, Air Ejectors, &c.

The specification, drawings, &c., may be inspected at the office of Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W.1, to whom all technical inquiries should be addressed.

Copies of the specification (in duplicate), together with copies of the drawings, general conditions, and form of Tender, may be obtained on written application to the Borough Treasurer at the Town Hall, Fulham, S.W.6, accompanied by a deposit of £5. This deposit will be returnable only if the tenderer shall have sent in a bona fide Tender within the prescribed time and shall not have withdrawn the same. Additional copies of the specification may also be obtained upon payment to the Borough Treasurer of £1 for each copy, which will not be returnable.

Tenders must be submitted in the printed envelopes provided, and all Tenders must be sealed and appropriately endorsed and delivered to the undersigned not later than 10 a.m. on Saturday, the 29th day of October, 1932.

The Council will not consider any Tender which does not cover the whole of the works specified. The Council will also not necessarily accept the lowest or any Tender, or compensate for the preparation of unsuccessful Tenders.

WILFRED TOWNEND,
Town Clerk.

Town Hall, Fulham, S.W.6. 9012

The Engineer

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PUBLIC NOTICES.

Metropolitan Water Board.

DISPOSAL OF SURPLUS PLANT.

The Metropolitan Water Board invite TENDERS for the DISMANTLING, PURCHASE, and REMOVAL as Surplus Plant of SIX COMPOUND ROTATIVE BEAM ENGINES and SEVEN CORNISH BOILERS, at their Surbiton Works, Portsmouth-road, Surbiton, Surrey.

The plant may be inspected at the above-mentioned works, between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon), on application to the Resident Engineer.

Forms of Tender in duplicate, containing particulars of the plant and conditions of sale, may be obtained from the Chief Engineer by personal application at the offices of the Board (Room 155), or upon forwarding a stamped addressed sack envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board, and endorsed "Tender for Surplus Plant," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 17th October, 1932.

The Board do not bind themselves to accept the highest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C.1,
22nd September, 1932. 9002

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

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PUBLIC NOTICES.

Pontefract Corporation Water-Works.

EGGBOROUGH PUMPING STATION.

The Corporation of Pontefract invite TENDERS from firms of competent Engineering Contractors for the ERECTION of a PUMPING STATION at Eggborough, comprising Engine-house with Reinforced Concrete Basement, Boiler-house, Coal Store, and Chimney, Concrete Foundations for and the Fixing of Two Sets of Vertical Triple-expansion Steam Engine Pumps and Boilers, a Concrete Covered Reservoir, 20in. to 6in. Cast Iron Mains and Stoneware Drains, an Engineer's Cottage, and other appurtenant works.

The drawings and specification may be seen at the office of the Consulting Engineer, Mr. F. Walter Hodson, M. Inst. C.E., at Bank Chambers, Loughborough, from whom copy of the schedule of works may be obtained on deposit of cheque for £5 5s., which will be refunded on receipt of bona fide Tender and the return of the documents.

The drawings and specification may also be seen at the office of the Borough Engineer, Municipal Offices, Pontefract.

Tenders are to be sent to the undersigned so as to arrive not later than 24th October, 1932.

The Corporation do not bind themselves to accept the lowest or any Tender.

G. WILKINSON,
Town Clerk.

Municipal Offices,
Pontefract. 9008

SITUATIONS OPEN (continued).

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SITUATIONS OPEN (continued).

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The Engineer

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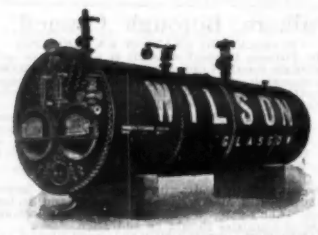

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Boiler Explosions.

WE learn from the annual report of the Board of Trade upon the Working of the Boiler Explosions Acts of 1882 and 1890, that during the year ended December 31st fifty-nine failures were the subject of inquiries; that seventeen persons were killed; that fifty-six were injured; and that the said deaths were caused by eight explosions on land and two in ships. All the inquiries are summarised in tabular form, and a short analysis of them may prove interesting. The first fact that strikes one is the influence of age. Beginning at the youngest, we find eight failures at under five years of age—some still in infancy; ten between five and ten years of age; four between ten and fifteen; eight between fifteen and twenty; four between twenty and twenty-five; and thirteen between twenty-five and forty, but to this last number must be added a large proportion of eleven failures at unknown or unascertained ages. As one might almost expect, the oldest "boilers" are the most subject to explosions; but the low figure of four each between ten and fifteen and twenty and twenty-five years is interesting. Of course, a great many of the failures are not connected with real boilers. Analysis shows that thirteen pipes and valves, fifteen pans, callenders, &c., seven tubes in bakers' ovens, six heating boilers, and one economiser "exploded"; whilst the number of steam generators was seventeen of various types, the single-ended marine leading with a total of nine. Out of the total of fifty-nine victims, twenty-two were not inspected and/or insured, and thirty-seven were. Amongst the causes of the failures, over-pressure and over-heating are the most numerous—seventeen all told—but eleven are attributed to corrosion, two to erosion, and five to water hammer. Curiously enough, only one failure was caused by shortage of water.

The British Commercial Gas Association.

AT the twenty-first Annual Conference, held in Leeds, at the beginning of the week, the British Commercial Gas Association celebrated its coming of age. The President this year is Councillor G. A. Kitson, the chairman of the City of Leeds Gas Department. The Conference was attended by over 400 engineers and managers of gas undertakings, and the technical papers read covered a wide range of interest. The President took as his subject "The Future of a National Industry," and outlined some of the possibilities of a national development of gas supply. In a paper on "Industrial Gas Achievement and Prospect," Mr. A. W. Smith, the general manager and secretary of the City of Birmingham Gas Department, dealt with the use of gas in varied industrial undertakings, and outlined its competitive value as against solid fuels and electricity. An interesting section of this paper was devoted to a consideration of the use of compressed gas at 3000 lb. per square inch for motor cars, emergency and peak load lighting, and for use aboard ship. Subject to compliance with Home Office requirements, experiments on compressed gas stored in steel bottles for motor car and lorry work, he said, were being carried out by the Birmingham Gas Department. At the annual banquet held on Tuesday evening, September 27th, Prince George was the honoured guest of the Association. In presenting the report and accounts, Sir Francis Goodenough, executive chairman of the Association, spoke of the value of co-operative publicity and trade enterprise, and the necessity for trained salesmen, having in view the demands which would be made by the future development of the gas industry.

Measuring to Millionths.

A PAPER by Messrs. J. E. Sears, jun., and H. Barrell in the September number of the *Philosophical Transactions*, describes an apparatus called the Wave-Length Comparator, which has been constructed at the National Physical Laboratory for the purpose of comparing the length of a wave of the red light from a cadmium lamp with the lengths of the present fundamental standards of length, known as the Imperial Standard Yard and the International Prototype Metre. It is anticipated that it may be possible in future to supersede the present definition of the units of length, which is based on the distances between terminal lines marked on these standards, by a definition in terms of the "natural" standard of length offered by the wave-length of a monochromatic ray of light. Among the advantages to be obtained in making this change are the avoidance of the risks of variation and damage associated with the present material standards. Another important advantage of the new unit lies in the increased precision it affords in the measurement of length. Since there are over 1,400,000 waves of the red ray of cadmium contained in the yard length, and this number can be measured in the new comparator to less than one-twentieth of a wave, the accuracy of measurement corresponds to 1 part in 30,000,000, or about one-millionth of an inch in a yard. Whilst practical, every-day measurements of length would not be appreciably affected by the change in the definition of the unit of length, at the same time it may be said that the continuous demand for increasing accuracy in industrial measurements makes an improvement in the accuracy of definition of the fundamental units of length no mere academic ideal, but a practical desirability. For the best class of gauge work, measurements to the millionths of an inch are actually required for small sizes at the present time.

British Trade Exhibition in Copenhagen.

THE British Industries Exhibition, which is being held in the Tivoli Gardens, the Industrial Hall, and the Forum Exhibition Hall, Copenhagen, was formally opened by the Prince of Wales on Saturday last, September 24th. Some 500 British firms are displaying their goods, and among them there is an excellent representation of British engineering, shipbuilding, electrical products, and our road, rail, and air transport industries. The Exhibition will remain open until Sunday, October 9th, and special facilities for inspecting it have been arranged by the Danish Railways and the Danish Steamship Companies. At the inaugural ceremony the Prince was warmly welcomed by the Lord-Lieutenant of Copenhagen, Monsieur Stauning, the Danish Prime Minister, and the Crown Prince of Denmark, who shares with him the co-protectorship of the Exhibition. In his speech the Prince of Wales referred to the trade relations of our two countries, and the part played in arranging the Exhibition by the Danish-British Association. Major Colville, the Secretary of the Department of Overseas Trade, also spoke, and expressed his appreciation of the part Denmark has played in connection with the Exhibition. In its first week the Exhibition has attracted wide attention in Denmark and in the surrounding countries, and already some important orders have been obtained by British firms as a result of their exhibits.

The Institution of Automobile Engineers' Journal.

THE continued growth of the Institution of Automobile Engineers, with ever-increasing activities at headquarters, seven provincial centres, and the New Zealand branch, has made desirable the adoption of better means of keeping in touch with members, and helping them to appreciate more fully the privileges of their membership. It has therefore been decided to publish several times a year a "Journal" instead of the usual leaflets regarding the activities of the Institution. This journal, of which the first number lies before us, contains advance copies of papers, and will also give a summary of the discussion on papers. Separate copies of papers, which were previously available at meetings, will no longer be distributed. A feature of the "Journal" is the inclusion of book reviews written by specialist members, and the first issue appropriately contains a brief epitome of the chief events in the history of the Institution since its inception. We extend our congratulations to the President, Mr. W. A. Tookey, the Council, and to Mr. Basil Joy, the secretary, on the new venture, which we feel will be appreciated by all interested in the work of the Institution.

Wireless Receivers.

A REPORT of considerable importance to manufacturers of wireless receiving sets and, in fact, to all who are interested in the technical side of wireless communication, has been issued from the Radio Research Board of the Department of Scientific and Industrial Research. Last year the Board appointed a Committee under the chairmanship of Dr. E. V. Appleton, to examine the properties of very highly selective receivers and the report to hand deals with the conclusions arrived at. The Committee has confined its attention to receivers in which high selectivity is attained by the use of radio frequency circuits of exceptionally low decrement, combined with audio frequency tone correction, and to answering in this connection the questions whether the performance of such receivers is consistent with hitherto accepted theory, and what are the advantages or disadvantages of such receivers in relation to practical problems of discriminating between wanted and unwanted stations. In connection with the first question, it is stated that the behaviour of receiving circuits of very high selectivity combined with tone correction, and including circuits in which the high selectivity is attained by the use of quartz crystal resonators, has been found to be quite in accordance with that predicted from the usual side-wave analysis. The combination of very high selectivity with suitably designed tone corrected and, if necessary, frequency limited audio frequency amplification, affords a means of effectively reducing that interference which is due to the reception of the direct modulation of a transmission on a neighbouring carrier frequency, but no immunity is afforded against those heterodyne interactions involving the wanted carrier wave which produce audio frequency components within the range required for the wanted modulation. In fact, in relation to the reception of broadcast telephonic transmissions of the normal double side-band type, a receiver designed on these or any other known and practicable principles, can only be expected to give reception free from interference between the wanted carrier and unwanted side waves, provided its response is limited to those audio frequencies which are less than half the frequency difference between the two transmissions, and provided the audio frequency range of the modulation of each transmission is similarly limited.

The New Italian Liner Rex.

ON Tuesday last, September 27th, the new 50,100 gross ton liner "Rex," built at the Ansaldo Yards, Sestri Ponente, Genoa, for the New York service of the Società Italia Shipping Company, left Genoa, on her maiden voyage, having undergone successful official trials. She is the largest ship constructed in an Italian yard, and has a length of 833·8ft. between perpendiculars, a beam of 97·1ft., and a depth of 47·3ft. Her hull equipment and safety and navigation devices incorporate the latest advances made. She is propelled by a four-screw arrangement of H.P., I.P. and L.P. turbines, each turbine unit being coupled through ten to one single-reduction gearing to the propellers. The turbines have a normal output of about 100,000 S.H.P., but during the full-power trials over 120,000 S.H.P. was developed, corresponding to a speed of over 28 knots. The turbines and boilers are arranged in separate water-tight compartments, and the boilers comprise eight double-ended and four single-ended water-tube units, with two low pressure auxiliary cylindrical boilers. They are all oil-fired under closed stokehold conditions, the working pressure of the main boilers being about 385 lb. per square inch, with 700 deg. Fah. steam temperature, and that of the auxiliary boilers about 230 lb. per square inch. The trials, we understand, gave results in excess of the guarantees.

An Improved Trade Balance.

AN interesting survey of the position of British trade for the eight months up to August 31st, is given in the recently issued Bulletin of the Empire Industries Association. The figures there presented show that in the period under review, imports declined by £87,000,000 in comparison with the corresponding period of last year; but exports fell by only £26,000,000, leaving an improvement on the balance of trade of £61,000,000. These figures, the Association contends, show that the prediction of Free Traders that restriction of imports by means of tariffs necessarily causes a corresponding decrease in exports is not borne out by the facts. On the contrary the trade returns show clearly that whereas the quantities of manufactured goods imported have largely declined, on the other hand, the quantities of non-dutiable raw material which have been imported have expanded. Noteworthy increases are those recorded for raw cotton, silk, flax, hides and skins, and paper-making materials. The figures for iron and steel show that imports fell from 202,000 tons in August, 1931, to 105,000 tons in the same month of 1932. Imports of sheet and tin-plates during the eight months, January to August, 1931, totalled 410,000 tons. This fell to 319,000 in the corresponding 1932 period, and for the month of August alone the decline was from 54,000 tons to 20,000 tons. Exports of sheets and plates of all kinds in the first eight months of this year totalled 691,000 tons, as compared with 562,000 tons in the same period last year, and for last month alone exports were 87,000 tons, compared with 70,000 tons in 1931.

The Late Sir Percy Girouard.

WE regret to learn that Colonel Sir Percy Girouard died last Monday in a nursing home in London. An operation had been performed on the previous Saturday, but the effort to save his life was unavailing. Sir Percy was a French-Canadian, born in the Dominion, and was sixty-five years of age at the time of his death. He joined the Royal Engineers in 1888, and first made his mark in the reconstruction of the railway from Sarras to Akasha and Kerma, connecting two navigable reaches of the Nile, at the time when Kitchener was given command of the Dongola Expedition. It was while employed on this work that his great administrative capacity became apparent, and in spite of the difficulties involved, the railway was completed in less than a year. For this work Lieut. Girouard was given the D.S.O., and was subsequently appointed to the post of Director of the Sudan Railways, and later made President of the Egyptian Railway Board. In the South African War Girouard, now a major, served as Director of Railways for the Field Force. It is believed that he was the first to foresee the possibilities of an armoured train. As a reward for his work he was created K.C.M.G., and was appointed Commissioner of Railways in the Transvaal. In 1908 he was given the Governorship of Northern Nigeria, and later held the same position in British East Africa. Although he retired from the service in 1912 to join the board of Sir W. G. Armstrong, Whitworth and Co., Ltd., he gave his aid to Mr. Lloyd George during the war in speeding up the supply of munitions, and was later associated with the Ministry of Reconstruction.

The Laboratories of La Société Hydrotechnique de France.*

By M. P. LEROUX.

No. II. (*Conclusion*).†

II.—Experiments in River Hydraulics in the Beauvert Laboratory.

Many of the experiments carried out in the Beauvert laboratory having been made at the charges of private concerns, which, by virtue of a rule of the laboratory, remain sole proprietors of the results of experiments made at their request, the author must be excused for being able to give only very summary accounts of some of them, hoping, however, to succeed in abstracting all matter of practical interest inherent in studies of this kind.

Fig. 9—*Model of the Chambon Overflow Weir, Without Water.*

The laboratory of Beauvert is in part under cover, and in part in the open, providing, under especially favourable conditions, excellent facilities for the establishment of models. These facilities will be increased by the completion of the work, now in hand, of housing the 100 m. canal and enlarging the hall provided for experiments, which will materially add to the area of covered sites available for that work. The place where a model should be installed is in every case decided in view of the conditions which will allow of the best response to the requirements of its employment in research. Thus, there can be utilised, as may be required, a canal with a glazed wall, which lends itself more especially to the study of flow as seen in profile; the open grounds of the laboratory, or the large experiments hall. Examples of the work performed will now be given, a distinction being made between those which provide only hydraulic values, or data, and those which include the determination of scour.

Hydraulic Studies of Various Works.

Distribution of Pressures on Stoney Gates.—As described elsewhere (Communication of Monsieur P. Leroux to Section III. of the Congress), the canal with a glazed wall consists of a stretch of canal 100 m. (328ft.) long, and 2 m. (6·56ft.) wide, the right bank wall of which is replaced for about 10 m. (32·8ft.) by five panes of glass 20 mm. (0·787in.) thick, 1·7 m. (5·58ft.) long, and 1·2 m. (3·94ft.) in height, separated by mullions 30 cm. (11·8in.) in width. Behind these panes a trench has been excavated, to accommodate the observers of the phenomena studied.

In this glazed canal there are installed a number of models, of scale about 1/15, of Stoney gates, it being desired to determine the pressures on their surfaces, for various *régimes* of flow, in order to discover what is the profile ("profil") which, subjected to the least pressures, will require the least effort in the lifting gear. With this object, holes, each in communication with a water manometer, measure the pressures at various points on the gates. It is thus possible to draw the curves of pressure distributions, analogous to those established in current practice for the wings of aeroplanes, from which the information required can be found by means of the planimeter.

The Overflow Weir and Discharge Tunnel of Chambon.—The Chambon Barrage Company formed the project, since abandoned on account of the nature of the ground, of making, in a lateral depression near that in which the Chambon dam, on the Romanche, has been built, an overflow weir for the discharge of flood water above a certain level, the water flowing over this weir being passed through a discharge tunnel in rock. In order to find whether this combination would discharge the computed flows, the company asked the Beauvert laboratory to make experiments with a model of the works, on a reduced scale. This model, or, more precisely, one geometrically symmetrical for convenience in its installation, was made, to the scale of 1/12, at the end of the 100 m. canal, at a spot very suitable for the construction of a supply reservoir for the weir—Figs. 9 and 10. The model comprises the weir, the discharge channel, and the entrance to the tunnel. A preliminary experiment showed that for a depth over sill corresponding to 2 m. (6·56ft.) in the real work, the discharge through the tunnel fell short of that anticipated. The entrance to the tunnel was then modified by increasing the amount of funnelling, and a second trial showed that the modification gave satisfaction. The flow corresponded to some 350 mecusecs (12,360 cusecs) on the natural scale.

The Saint-Maur "Subterranean."—In order that it might be utilised as a flood relief work for the Saint-Maur bend on the Marne, upstream of its confluence with the Seine on the outskirts of Paris, the Ponts et Chaussées of the Seine are modifying the canal formed in the isthmus of Saint-Maur and long utilised for navigation. In order that their calculations might be confirmed by experimental verification the administration asked the Beauvert laboratory to make a model, on the scale 1/20, of this so-called "subterranean" canal of Saint-Maur and of its upstream and downstream connections. The model, which reproduces the canal with the proposed modifications, is made of concrete and is located on the experimental channels ground—Figs. 11 and 12. Its length is about 70 m. (230ft.). To facilitate the discharge of the water, the downstream work is a geometrically symmetrical reproduction of the real work.

Fig. 10—*Model of the Chambon Overflow Weir, in Action.*

Upstream, the bed of the Marne has been reproduced, with a sluice providing a flow corresponding to that of the river. Gauge wells, provided with reversed points controlled by micrometer screws, and communicating with basins formed in the bed of the canal and covered by metal plates pierced with holes, provide for the measurement of the water levels at a number of suitably chosen points.

The flows in the river and in the canal branching from it are measured by means of Bazin weirs, or notches, without end contraction.

The trials were made by the Ponts et Chaussées of the Seine and the laboratory in collaboration. They have fully verified the calculations for predeter-

Fig. 11—*Model of the St. Maur Work, Without Water.*

Fig. 12—*Model of the St. Maur Work, Filled with Water.*

Fig. 13—*Model of the La Jourdanie Weir, Viewed from Downstream.*

Fig. 14—*Discharge Over the Model of the La Jourdanie Weir, as Seen Through the Glazed Wall.*

* Translation in full of a paper presented at the Congrès de Génie Civil, held in Paris, September 23rd to 29th, 1931, and published in the July-August, 1931, *Bulletin* of the Société des Ingénieurs Civils de France. The Editor desires to thank Monsieur Leroux for the loan of the original blocks.

† No. I. appeared September 23rd.

mination of characteristics of flow and have also brought to light the following very interesting feature. On starting the experiments, it was found that the spread of the current at the downstream end of the canal was unsatisfactory, the current setting laterally with the creation of counter-currents and repeated surging. Various modifications were made to the downstream end work to remedy this state of things, and very satisfactory results were finally obtained by making the downstream expansion more gradual and aiding the spread of the current by a gentle reverse slope. The results obtained after these modifications had successively been made, which was easily done on the model, show the benefit to be derived from trials with such small-scale reproductions.

The Weir of la Jourdanie.—In order that attempts might be made to predetermine the flows over the weir under construction at la Jourdanie, on the Tarn, for various water levels upstream and downstream, there has been installed at the Beauvert laboratory, at the request of the Société L'Energie Electrique du Tarn, a model of that weir, scale 1/50, constructed in the glazed wall canal. In order to represent as fully as possible the real flow conditions, there is also reproduced, for a given distance upstream and downstream, the bed and the left bank of the river, the right bank portion of the flow being limited by the zones of still water alongside the glazed wall. Fig. 13 is a view of the weir from down-stream, some of the sluices being closed (partially) by shutters and one (wholly) by a stop-plank. There can also be seen the triangular notch used for flow measurements, after preliminary rating by comparison with a weir with side contraction. Fig. 14 represents one of the flow *régimes* studied, the photograph having been taken through a pane of the glazed wall.

Water manometers provide, on the one hand, for measurement of the head over the triangular notch; on the other hand, for that of the water levels in the still water zones upstream and downstream of the weir.

FIG. 15—*Masonry Work of the Model of the Kembs Works, Showing the Concrete Framework Provided for its Levelling.*

FIG. 16—*Model of the Kembs Weir, Viewed from Downstream, Showing the Regulation, as in the First Disposition, by Means of Vertical Openings.*

FIG. 17—*The Kembs Weir: View Showing Velocities with a Very Small Flow Over the Weir.*

Successive studies were made of this work, with all the sluices fully open; all partially closed by shutters; with one completely closed by a stop-plank; finally, with all the piers—or grooved posts—removed. With some *régimes* turbulence was a conspicuous feature, depending in form and character upon which of the sluices was closed by a stop-plank.

EXPERIMENTS INCLUDING MEASUREMENTS OF SCOUR.

Floors for the Pizançon Weir.—The Société Isère-Vercors, which had presented the laboratory with the glazed wall canal, was the first to utilise it, for trials of sills for the weir at Pizançon, on the Isère.

Three of the sluices of the weir were reproduced in wood at about the scale 1/30. The bed of the canal downstream was covered with sand, and experiments with a number of types of floor were made under different flow conditions, in order to find what arrangement would produce the least scour downstream of the weir.

Observation of the flow as seen through the glazed wall allowed the mechanism of the scour to be very easily followed. These trials, which included precise measurements of the scour in the different cases studied, led to the adoption of toothed outlet sills. [Probably on the Thünau system, as adopted at, for instance, the Ladenbourg lock on the Rhine-Neckar Canal:—A row of concrete teeth, pointing upstream, on the sill under the sluice gate, which has a recess for this row of teeth, closing downstream of them. The teeth are about 45 cm. (17·7in.) high and about 30 cm. (11·8in.) apart.—ED.]

The Intake Works at Kembs.—The Société l'Energie Electrique du Rhin requested the Beauvert laboratory to study the course of the Rhine in the neighbourhood of the Kembs weir and the entrance to the first reach of the Grand Canal of Alsace, in order to determine, from various elements of the flow, which were such as could be modified by the works then being carried out:—The distribution of velocities at different points, the modifications which would take place in the river bed, and the scour downstream of the weir. A model on the scale 1/200 was installed in the testing hall of the laboratory, the choice of the scale depending as much upon depth dimensions as upon horizontal dimensions. The results obtained being satisfactory, it was not considered necessary to repeat the trials with exaggerated depths, as is sometimes done in cases of that kind.

The model reproduced:—

The weir at Kembs, on the Rhine;

The course of the river to about 2 kiloms. (1·24 miles) upstream and to about 300 m. (984ft.) downstream of the weir;

The intake canal to about 400 m. (1312ft.) downstream of the intake groyne on the right bank.

The model has therefore a length of 12 m. (39·4ft.) and widths from 2 m. to 4 m. (6·56ft. to 13·12ft.). All the masonry work, weir, concreted banks, walls and moles, have been reproduced in cement or concrete. The natural soil has been reproduced with sand passing a sieve of 1·5 mm. (0·06in.) mesh, this dimension corresponding in scale to the largest stones (shingle) normally found in the soils of the area. Fig. 13 represents the masonry work before the placing of the sand.

In constructing the model the first step was to make a concrete framework, on the top of which there was formed a groove or small channel, which, when filled with water, gave a truly horizontal datum plane. This made it possible to put in place templates of sheet metal representing the cross sections of the river and the intake, the templates having been cut to the scale dimensions of the cross sections of the river at corresponding points. By their means the banks and bed of the river and of the intake were reproduced at each of these points in suitable materials. The shutters of the weir were, for each sluice, two small zinc plates, representing the two parts, and capable of being placed in all positions corresponding to those of the two elements of the real shutters.

The stop gates of the sluices were similar zinc plates, which were staunched by means of red lead putty in the stop-gate grooves provided in the barrage weirs (Fig. 16).

An assured supply of water was derived from a reservoir kept at constant level by overflow and replenishment by pumping. The pipe line from the reservoir was provided with a 40 mm. Rateau metering tube ("tuyère Rateau") calibrated in the laboratory, for the measurement of total flow, and with a flow regulating valve. The delivery end of the pipe was fitted with a baffle—or anti-turbulence—tube in a basin upstream of the model and separated from it by a broad-silled weir. Downstream of this weir a second basin, in which a raft floated, preceded the entrance to the model proper.

The depths of water required downstream of the weir and the intake were assured by sluice shutters, each comprising two plates pierced by vertical slots (Fig. 16) grille fashion, with their surfaces in contact, one being movable and sliding horizontally over the other, which was fixed. By means of a screw and nut adjustment the blind portions of one plate blocked more or less, the slots in the other. Thus there were obtained flows regular throughout their depth, in contrast with such as are produced in regulation by means of a weir sill, which only allows of surface flow or, in the case of an undersluice, of flow from the lower strata of the water only.

The water flowing from the intake was passed through a vertical pipe 30 cm. (11·81in.) in diameter and about 1·25 m. (4·1ft.) in height, at the bottom of which was fixed, axially, another Rateau metering tube of 20 mm., calibrated at the laboratory, to measure the flow from this intake.

A differential water manometer and depth scales with point indexes provided for the measurements of the heads on both sides of the metering tube ("tuyère de mesure") on the supply pipe of the water levels, upstream and downstream of the weir, and of the head over the metering tube measuring the flow of the intake.

The model having been thus constructed, the various determinations were made in the following manner:—

Distribution of velocities.

Attached to threads strung across the current above the highest level to which the water would reach, threads of worsted smeared with tallow floated on the surface of the water and aligned themselves with the direction of the surface velocity at every point. The positions of all these threads furnished for a particular *régime* a kind of picture of the corresponding velocities.

Magnitude of the velocities.

By means of a seconds counter calibrated in the laboratory, records were made of the times taken by ballasted floats in their passage between reference stakes at given distances apart, the mean being about 1·5 m. (4·92ft.).

Deformations of the bed upstream of the weir.

These deformations were measured after a flow had continued for a given time; by replacing the templates used in the construction of the model so that the hollows and areas of accretion were made apparent.

Measurement of scour downstream of the weir.

After a period of given flow contours of the bed downstream of the weir and, later, of the bed immediately upstream of the piers were taken by means of a plumb line suspended from an apparatus carrying a perfectly horizontal arm rotating around a perfectly vertical axis. The plumb line being marked in centimetres, levels could be taken at points fixed by measurement along the horizontal arm. The contours thus obtained were afterwards put in evidence by means of white worsted threads.

Four *régimes* of flow were studied, distinguished by the total flows at the weir and through the intake, and the water levels upstream and downstream of the weir.

The flow through the intake, which was the same in all the experiments, corresponded to a real flow of 850 mecusecs (30,019 cusecs). The total flow corresponded to a range of 1085 to 3530 mecusecs (38,318 to 124,665 cusecs).

The levels upstream of the weir corresponded, for the various *régimes* studied, to cotas 1 to 4 on the scale at Bâle.

The results of these very thorough experiments cannot here be presented as a whole. It must suffice to describe them in outline and to give some examples, Figs. 17 to 21.

Fig. 17 is the presentment of velocities for the smallest total flow. The flow over the weir being, then, almost nil, one sees very clearly near the left hand of the river upstream a zone of eddies and counter-currents, and a degree of indefiniteness in the distribution of velocities. This zone diminishes and finally disappears with greater flows.

The scour downstream of the weir was measured

for the three greater total flows, 1730, 2540, and 3530 mecusecs (61,097, 89,703, and 124,665 cusecs) and flows at the weir 880, 1690, and 2680 mecusecs (310,781, 59,684, and 94,647 cusecs), each being maintained for a determined period.

Figs. 18, 19, and 20 respectively show the scours with the second sluice from the left bank closed after 8 hours of a flow of 1730 mecusecs, after 4 hours of a flow of 2540 mecusecs following the former, after 2 hours of a flow of 3530 mecusecs following the two preceding flows. Fig. 21 relates to an exceptional supplementary experiment, lasting 2 hours, during which the depth above the weir was increased to that corresponding to 1 m., and the same maximum flows were maintained as in the preceding experiment.

On the photographs, the elevations of the contours have been replaced by figures corresponding to the altitudes in the real work.

It may here be noted that in the relation between the model and the work itself, the Reech-Froude law of similarity was applied, which is, as is well known, if not completely applicable, at least the best for cases of this kind.

Overflow Weir of the Romanche.—The trials, with a model of scale 1/50 of this weir, shown in Figs. 22 and 23, are now being carried out at the request of the Ponts et Chaussées de l'Isère.

The investigation relates to one of the two identical weirs, 90 m. (295ft.) in length, which it is proposed to provide in the Bourg d'Oisans plain, to allow during floods of the river water being spread over adjacent low-lying areas. The problem consists in a study of the scour caused in those areas downstream of the weirs.

The first experiments suggested the idea of giving a counter slope to the weir—that is, a slope in the opposite sense to that of the river bed, which can very easily be done with the model by making it pivot, as a whole, round a horizontal axis perpendicular to its (up and downstream) direction, and passing through a determined point in the downstream part of it.*

III. Collaboration of the Saulcy and Beauvert Laboratories.

It would be superfluous to dwell upon the interesting character of trials of models of reduced size. The nature and the number of the experiments which have been made or are now being carried out at both Beauvert and Saulcy would suffice to give fresh proof of it, if that were needed.

The author believes, however, that he can give some examples which demonstrate in a very striking manner the value of studies of this class.

One of these is supplied by the trial at Beauvert of the "Subterranean" of Saint-Maur, the headwork of which was the subject of a number of successive modifications before giving satisfaction. Now, in the model of scale 1/20, the volumes in the real work proportionate to those in the model—the masonry, for example—are in the proportion of 20 cubed or 8000 to 1. Allowing for the fact that a cubic metre of masonry in the model, relatively fine material, costs two or three times as much as a cubic metre of masonry in the real weir, a given piece of work would cost from 3000 to 4000 times as much on the weir itself as on the model. For example, the expenditure of 1000f. for a modification of the model allows of a saving of from 3 to 4 million francs in works on the weir itself, without taking into account the relative periods required for the work in the two cases, or losses of time or delays and all their consequences, which can be avoided by a preliminary trial with a small-scale model.

Yet another example is provided by the discharge weir of the Romanche. It has been explained that the model was to be made to pivot on a horizontal axis, to give it a counterslope or several counterslopes in succession. Thus a number of dispositions can be rapidly and easily studied, each of which would require, in actual practice, the complete demolition and reconstruction of the crest of the weir, and, in every case, waiting for a flood in order to be able to judge the results.

If, however, one refrains from discussion of the value of trials with small-scale models of hydraulic works on rivers, one might, on the other hand, be tempted to express surprise in that the Société Hydrotechnique, with its two laboratories of Saulcy and Beauvert, capable of undertaking analagous researches, seems to be more or less competing with

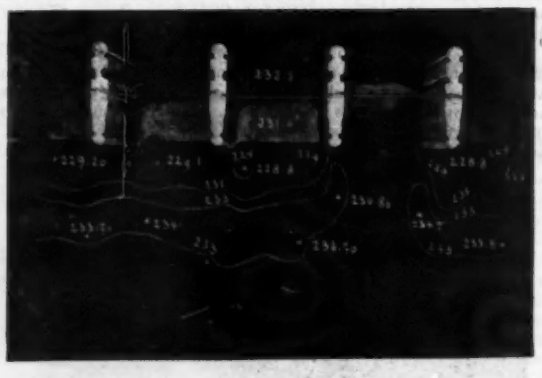


FIG. 18—*The Kembs Weir: Condition Downstream After a Flow Corresponding to 880 Mecusecs.*

FIG. 19—*The Kembs Weir: Scour Caused by a Flow Corresponding to 1690 Mecusecs.*

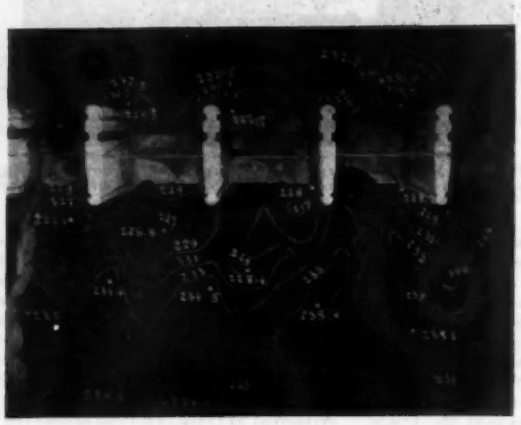


FIG. 20—*The Kembs Weir: Scour Caused by a Flow Corresponding to 2680 Mecusecs.*

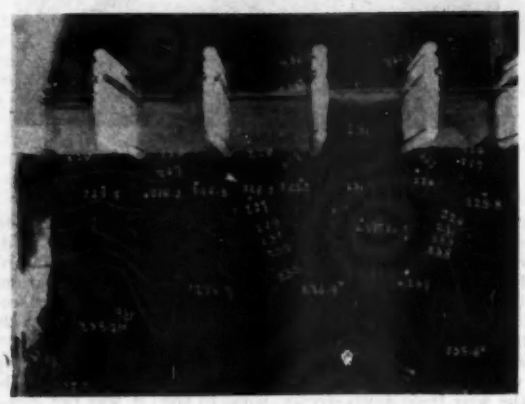


FIG. 21—*The Kembs Weir: Scour After the Experiment with the Raised Water Level Upstream.*

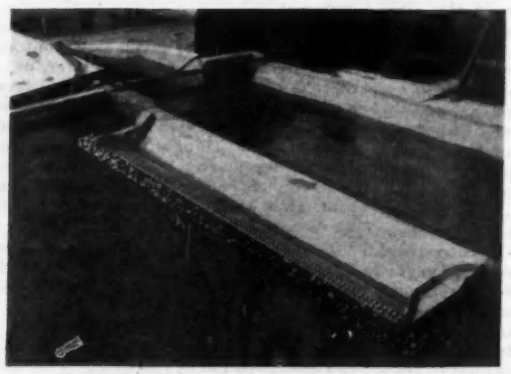


FIG. 22—*Model of an Overflow Weir of the Romanche in the Dry.*

FIG. 23—*Model of an Overflow Weir of the Romanche in Action.*

* The experiments which were in hand at the time of writing have now been concluded. They have made it possible, with complete success, to study various inclinations of the weir and various values for its height in relation to the land downstream.

itself by creating two similar establishments. This is, however, but a seeming anomaly, for the two laboratories are, on the contrary, called upon to complement themselves by means of close collaboration.

It is, indeed, proper to remark, in the first place, that the value of an establishment of this nature depends in some measure upon conditions of a regional character. For works of any importance it is especially desirable that the laboratory be not too far from the work, and it is particularly convenient for the engineers of the Ponts et Chassées de l'Isère, for instance, to follow at Grenoble the course of trials of the weir of Chambon or that of the Romanche. Moreover, it does not suffice that problems of river hydraulics be presented only in respect of streams in mountainous regions, for the *régime* of streams in the plains equally demands profound study of the conditions of their flow, an example of this being furnished by the experiments which are being carried out at Saulcy on canals of complex cross section, very slight bed slopes, and relatively large flow.

But the conception of the true collaboration of the two laboratories has been engendered by considerations of deeper significance. A brief reference has been made to the inadequacy of the Reech-Froude law of similarity, customarily followed in river hydraulics, in the transition from the model to the full-scale work. Really, no law of similarity is fully applicable to all the phenomena to which an experiment gives rise. Moreover, even in studies of hydraulic machines it has been sought, not without success, to turn the flank of the difficulty by testing several models of the same machine to different scales, so as to draw for each element of the problem a kind of curve which one tries, by extrapolation, to extend to the full-size machine.

Such a method is even more necessary in river hydraulics, in which disturbing factors, such as friction, independent of all laws of similarity, have a relative importance far greater than in the field of machines, pumps, or turbines. It is for this reason that experiments at Saulcy were made with two models, on the scales 1/20 and 1/50, of the bi-trapezoidal canal.

Foresight, in regard to collaboration between the two laboratories of the Hydrotechnical Society was exercised with precisely the same idea in view. Though no defined boundary divides their respective fields, the Beauvert laboratory, as a part of this combination, is adapted to experiments on small and middle scales, while that of Saulcy is intended for those on middle and large scales. It will be realised what inferences can thus be drawn from simultaneous studies in these two establishments of the same work on different scales.

It seems, then, that the Hydrotechnical Society provides for industrialists two institutions in full activity and capable of tackling all the problems which daily arise in connection with large hydraulic works, which are themselves in a specially active phase of their development; while, as was pointed out in the opening paragraph of this paper, these are not the only laboratories concerned with such matters.

There is therefore no obstacle to the continued development in France of hydraulic tests of small-scale models, along the same path as that which seems to be so resolutely followed on the industrial side, and this newly formed collaboration between the workshop and the laboratory will soon be marked by conspicuously successful results.

Iron and Steel Institute and Institute of Metals.

No. II.*

IRON AND STEEL INSTITUTE.

NON-METALLIC SYSTEMS.

On Tuesday, September 13th, at the afternoon session, a paper on "The Equilibrium of Certain Non-metallic Systems" was presented by Professor J. H. Andrew and Mr. W. R. Maddocks.

Professor C. H. Desch, discussing the rising particles referred to in the paper, said metallurgists were getting from Professor Andrew's work, and from work carried out in America on inclusions, a large quantity of information as to the nature of the separate globules which formed inclusions in steel. The beneficial effect of manganese as a deoxidiser, as compared with other deoxidisers, in all probability depended on its capacity for forming comparatively large globules which would float to the top and eliminate themselves more rapidly than smaller globules, and that was likely to be connected much more with the surface tension than with the density. He suggested that a physicist accustomed to high-temperature work might undertake the determination of the surface tension of the binary mixtures on which Professor Andrew was working.

Mr. S. A. Main emphasised the importance, to the Institute's Committee on the Heterogeneity of Ingots of fundamental work of the kind described in the paper. The Committee had studied the distribution of the segregates in ingots so far as they possibly could, and wanted fundamental details as regards their formation. In particular it was important to find that the particular constituents with which Professor Andrew and his colleagues had been working could combine, even if only in small proportions, because these segregating elements seemed to coalesce more or less; they formed the same segregation pattern in the ingot, and unless one could see why, it was very difficult to understand why insoluble elements should behave in much the same way as elements believed to be soluble. With regard to the upward flotation of segregates, the rates of rising calculated in the paper were of sufficient magnitude to be of importance in the solidification of ingots, especially large ones, because very many hours elapsed before they were completely solid, and if the segregates in the fluid steel could rise at the rates indicated, that fact could have a very important influence on the positions in which the segregates were found when the ingot was solid.

Professor Andrew, replying, said he would like to take surface tension measurements, as suggested by Professor Desch, but they were very difficult. With regard to Mr. Main's reference to the segregates coalescing, and the fact that, whatever the nature of the non-metallic inclusions, they were invariably associated one with another, he considered that was due largely to the fact that there would be a tendency for the silicates to associate so as to give a mixture having the lowest melting point in order to approach nearer to the state of maximum entropy.

A paper on the "Time-potential Curves on Iron and Steel and their Significance," by T. P. Hoar and U. R. Evans, was then presented and briefly discussed.

It was followed by a paper entitled "The Effect of Hydrogen Sulphide on the Corrosion of Iron by Salt Solutions," by S. C. Britton, T. P. Hoar and U. R. Evans, on which there was no discussion.

SCALE REMOVAL BY ACID PICKLING.

Messrs. A. B. Winterbottom and J. P. Reed then presented a paper, with the title given above. In it the physical chemistry of scale removal from mild steel is investigated, and views regarding its mechanism put forward. Works practice is then discussed, and a rational procedure for pickling outlined.

Dr. J. W. Jenkin pointed out that when pickling was carried out in sulphuric acid or hydrochloric acid, and if a certain amount of the acid remained on the surface of the material, as was always possible, it would give ferrous sulphate or ferrous chloride, which would not be protective; but if phosphoric acid were used, it would give ferrous phosphate, which, according to the paper by Mr. Hoar and Dr. Evans, dealing with time-potential curves on iron and steel, would be protective. Therefore, it was significant to read the two papers in conjunction. It might be argued that pickling in phosphoric acid would involve high costs, but when one considered hot rolled sections, to be painted subsequently, for structural steel work, for example, it might be that if phosphoric acid were used for pickling, the surface would be protected until it was painted, whereas, if sulphuric or hydrochloric acid were used for pickling, there would be no protective action from any salts which were left. In spite of any qualms one might have about the economics of pickling by phosphoric acid, it was being done on a commercial scale, though not in this country, so far as he knew. With regard to the metallographic method evolved in his department for examining sections of scale, he said that at Mr. Winterbottom's suggestion he had tried bakelite powder. That was subject to difficulties, but if it were used under pressure, and at a temperature of 240 deg. Cent., one could get very fine edges. Methods for the examination of very fine cracks on those lines would show cracks quickly.

Dr. J. C. Hudson said that in many cases where structural steel or ironwork was exposed to corrosion the initial stages were the most important, and the condition of the material in those stages was very often determined by the outer layers of scale rather than by the underlying metal. For that reason the Corrosion Committee had always recognised the fundamental necessity for a thorough investigation of the properties of rolling scale produced on iron and steel under commercial conditions, and Dr. Jenkin had undertaken to assist the Committee by carrying out in his laboratory an exhaustive examination of all the materials subjected to the Committee's corrosion tests. No doubt Mr. Winterbottom and Mr. Reed were collaborating. It was of interest to note that the average thickness of the rolling scale on the ordinary structural mild steel used in the Corrosion Committee's tests was about 0·052 mm., and since the scale was produced at rolling temperatures between 1360 deg. and 1045 deg., he considered that figure to be in good agreement with the figure of 0·018 mm. given by the authors for a rolling scale produced at temperatures between 1000 deg. and 900 deg. Cent.

Commenting on the difficulties of obtaining reproducible samples, he illustrated the losses in weight from twenty-seven wrought iron specimens, cut from the same strip and carefully rolled. After weathering for thirty-nine days the losses varied from 106 to 280 milligrammes—in one extreme case 341 milligrammes—which gave an idea of the variations to be expected on ordinary commercial material.

The authors had shown that the time required to pickle the scales produced at lower temperatures was greater than that required to pickle the scales produced at higher temperatures. That agreed with the observation of the Corrosion Committee that the resistance of rolling scale to weathering or atmospheric corrosion increased generally to some extent as the rolling temperature fell. The authors' explanation, based on the fact that the ferrous oxide phase did not occur in appreciable amounts in the lower temperature scales, would be generally accepted in the case of pickling, and no doubt it would be found to be equally applicable to atmospheric corrosion.

Mr. A. Allison agreed that low-temperature scales were particularly obstinate, and added considerably to the cost of pickling. With regard to inhibitors, there was at least one, British made, of which the chemical composition was stated, and he suggested that the authors might have referred to it by name. His experience of pickling on a large scale entirely confirmed the authors' results with regard to times of pickling. Laboratory experiments, however, did not appear to correlate particularly well with practical work. Discussing the different sulphuric acids, he asked whether D.O.V. (distilled oil of vitriol) was a better pickling material than B.O.V. (brown oil of vitriol), *i.e.*, whether the surface produced with B.O.V. was inferior. As to the discarded pickling liquors, he said that at his works the copperas was recovered, and the saving just about met the cost of the labour involved in recovery.

Dr. L. B. Pfeil said there was a tendency to speak of scale as though it were a sort of compound, but it consisted of several different compounds, and the composition of the scale changed as the temperature changed. Its constitution at the ordinary pickling temperatures depended on the rate of cooling to some extent, and he suggested that that should be taken into account. He had reason to suppose that on slowly cooled specimens the inner scale layer dissolved more quickly than that of rapidly cooled specimens. It seemed that there should be encountered differences in pickling rates of steel plates according to whether they were cooled slowly or rapidly. As to the determinstion of the proportion of iron in the scale dissolved by the pickle, there was a good chance that the ferric materials in the scale would be reduced to ferrous by the nascent hydrogen evolved by the steel.

Mr. T. P. Hoar put forward an electro-chemical explanation for the removal of low-temperature scale, and this was amplified by Dr. U. R. Evans. It was that the attack of ferric oxide films was due to a short-circuited cell, and the ferric oxide was reduced to ferrous and then dissolved; it was not a direct attack of the acid on ferric oxide.

Mr. W. R. Lysaght (President-elect) asked if the authors could account for the fact that the time of pickling of various batches would vary from, say, six to thirty minutes in the course of a week.

Mr. Winterbottom, replying to Dr. Jenkin's suggestion with regard to phosphoric acid pickling, said that in the authors' view there was no difference in the primary action as between different acids. The fundamental action was that of the hydrogen ions on the ferrous phase, and therefore, it was general for any acid. Subsequent reactions might suggest the production of a phosphate film, and so on, but those were secondary matters. But it was obvious that they were of great importance when one was putting material into service as pickled. Material pickled in sulphuric or hydrochloric acid rusted with great facility, and indeed one wanted it to rust in cold working processes; but if one were going to paint the material one did not want scale on it, because of the brittleness and because it would interfere with the adhesion of the paint. On the other hand, one did not want traces of sulphuric acid left, and possible blistering of the paint film. Apparently in that connection phosphoric acid was going to be worthy of very serious consideration. In connection with the removal of low-temperature scale, it was difficult to define exactly what was meant by "completion of pickling." The scale just stayed there, and one could rub it off after a time, and the authors had had to devise their own method of determining when pickling was complete. The completion was not so clearly marked as in the case of the thicker high-temperature scales. The authors would prefer to consult before replying to the question with regard to possible differences between B.O.V. and D.O.V. acid. Replying to the explanation put forward by Mr. Hoar and Dr. Evans as to the removal of low-temperature scale, he said the authors had felt that the facts suggested solution of ferric oxide and then reduction, but they had not thought out the details. Finally, in reply to Mr. Lysaght, he agreed that pickling times, &c., varied in places where jobbing work was done, in small vats, and where there was no laboratory control.

The meeting then adjourned until Wednesday.

INSTITUTE OF METALS.

THE first paper read at the meeting of the Institute of Metals on Tuesday afternoon, September 13th, after the announcement of the Council's nominations for President, &c., was "The Effect of Pressure on the Liberation of Gases from Metals (with Special Reference to Silver and Oxygen)," by Mr. N. P. Allen, which was briefly discussed by Mr. W. P. Rees and Dr. D. Stockdale.

REMOVAL OF GASES FROM ALUMINIUM.

A paper entitled "On the Removal of Gases from Aluminium by Mixtures of Nitrogen and Volatile

* No. I. appeared September 23rd.

Chlorides," by J. D. Grogan and T. H. Schofield, was then presented. The authors claim that gas may be effectively removed from certain aluminium alloys by mixtures of nitrogen and certain volatile chlorides, the metal so treated being of excellent quality.

Dr. A. G. C. Gwyer said that whilst he had had no experience with the particular mixture the authors had dealt with, it seemed to present an improvement, in that it would obviously be cheaper to use and there was a reduction in the quantity of fume. It would be interesting to know how far the method described was being adopted industrially and on what scale. His own impression of this work in the past had been that when such methods were applied to large quantites the results were not so successful as with small quantities. That, however, was a general criticism, and it would be interesting to see this method adopted on a large scale industrially.

Mr. H. W. G. Hignett said that the process mentioned in the paper was a suitable arrangement for use in the foundry, and he had obtained some very good results with it on a very large scale. He had used melts up to about 300 lb., and the troubles experienced were chiefly due to the difficulty of getting sufficient area of contact of the mixture of vapour and nitrogen with the metal. When an apparatus was devised for suitably dividing the gas stream into small bubbles the results were very much better. Working with oil-fired furnaces for melting aluminium alloys he found that the temperature of 710 deg. for de-gassing mentioned by the authors was useless for quite a large number of castings, and working at 800 deg. it was found that the amount of gas that had been put into the metal was simply terrible. It was also found that as the temperature increased the difficulty of getting rid of the gas increased also, and that introduced a problem which the authors had not dealt with as yet.

Mr. E. L. Rhead recounted some experience, both with regard to the use of titanium in the manufacture of sound aluminium castings, and also the use of volatile chlorides in improving the casting properties of various alloys.

Dr. W. Rosenhain, dealing with the question mentioned by Dr. Gwyer as to the applicability of the authors' method and other methods of de-gassing on a large scale, said there was only one economic and satisfactory method of de-gassing, and that was never to let the gas get in, which was not an easy problem. But the method developed by the authors was extremely promising, and, indeed, he could say definitely that it had been used extensively on a large scale. However, such attempts had been rather crude because the gas was bubbled through the metal in great gulps. In other words, there were "dollops" of gas rising up through the metal and throwing the metal about. Frequently, the metal at the same time was exposed to a furnace atmosphere from which gas was being absorbed nearly as quickly as it could be removed. If instead of that the metal was heated under conditions in which the atmosphere was reasonably free from hydrogen and hydrogen compounds, and if the gas was used in the form of finely divided bubbles, carefully distributed throughout the whole mass, then success would definitely be achieved, and the amount of gas required would be found to be astonishingly less than was required in the crude attempts which he had sometimes seen and heard about. If aluminium was to be de-gassed in this way, it should be dealt with in a much more rational manner, and something should be learned from the steel industry in connection with it. Instead of bubbling gas through the metal in a more or less makeshift manner, we should use a vessel like a Bessemer converter heated—and if necessary pour the charge into it—in an atmosphere entirely away from the products of combustion, and then blow the gas carrying the volatile chlorides through the tuyere or perforated bottom of the converter, so as to divide it thoroughly and mix it in a fine state of division with the metal.

Professor D. Hanson remarked that his experience had been that whilst all these gas removal processes improved the metal to such an extent that it could be called technically quite sound, if the metal was examined microscopically it still contained a considerable amount of gas; 1 per cent. or even more in minutely distributed pin holes was by no means uncommon. Therefore, it was necessary to have some standard, either a pictorial one or a more exact quantitative one, than the authors had given if the results of different investigators were to be compared. The difficulty of applying these processes on a large scale was very real, and if the nitrogen was to be subdivided sufficiently finely then it would have to be very pure, because not only would there be more intimate contact between the active elements and the metal, but there would also be more intimate contact with the oxygen contained in the nitrogen, and the production of an oxide film was a very serious trouble when treating metal with an oxygen-containing gas. It was doubtful if any of the gas-removing processes yet devised were capable of application on a large scale practically, except in special cases where the high quality of the material justified the trouble and the expense involved. This problem was a very much more difficult one with aluminium, because of the oxide film, than with a metal like copper and the only real solution was to use a good aluminium and to melt it and store it under proper conditions.

The authors will reply in writing.

The following two papers were then presented and discussed together:—"Researches on Beryllium," by H. A. Sloman, and "Some Attempts at Making Beryllium-Magnesium Alloys," by R. J. M. Payne and J. L. Haughton.

They were followed by one on "The Constitution of the Lead-tin Alloys," by D. Stockdale, and another on "The Effect of Different Elements on the Annealing and Grain Growth Characteristics of Alpha Brass," by Messrs. M. Cook and H. J. Miller.

The final paper at the Institute of Metals meeting on Tuesday afternoon, September 13th, was by Mr. J. H. Watson, on "Liquation or 'Inverse Segregation' in the Silver-copper Alloys." There were fair discussions on all these papers.

(To be continued).

Precision Grinding Machines.

No. II.*

CYLINDRICAL GRINDING—EXTERNAL.

THE modern precision grinding machine had its origin in the days before the researches mentioned in the first article of this series gave engineers the command of artificial abrasives. For example, Ambrose Webster in or about the year 1861 produced a machine for grinding cylindrical work externally. It was simply a lathe, with the work mounted between centres, and with a separately driven grinding wheel mounted on the tool slide in place of the cutting tool. In so far as this machine gave a defined movement of the work relatively to the grinding wheel, it embodied the principle of the precision grinder and marked a fundamental departure from previous grinding practice, in which the work was simply held against the rotating stone by hand or in some equally indefinite manner.

Webster's and other early machines were designed to supplement the lathe, the object being to secure a greater accuracy and a better surface finish than could be obtained by turning. It was natural therefore that they should take the form of machines closely resembling lathes, and that at first precision grinding should be confined to external cylindrical surfaces. External cylindrical grinding probably still provides the largest field of application for precision grinding. The machines employed have, however, become so highly developed that except for the fact that the work is carried between centres they no longer bear any close resemblance to a lathe. Even in the excepted characteristic they sometimes show no trace of their descent, for within recent times a considerable amount of employment has been found for the centreless grinder, a machine in which the work is not supported between centres having any physical reality.

As a modern example characteristic of its class and illustrating the extent to which the cylindrical grinder has evolved away from the lathe, we illustrate on page 332 a large external grinding machine made by John Holroyd and Co., Ltd., of Milnrow, Rochdale. This machine has been designed to deal with rolls, tubes, and similar articles up to 24ft. in length which have to be ground either parallel or taper on their external surfaces. With a wheel, 24in. in diameter, it can grind work up to 30in. in diameter. In a machine of this class and size satisfactory operation depends upon the rigidity of the bed, the head and tail stocks, and the grinding wheel head. Vibration in any part would be fatal to good grinding. With a high-speed drive to the wheel passing through long shafts and transmitted through a number of gear trains, vibration can readily be set up if great care is not exercised in the design and construction of the machine. An additional source of trouble lies in the possibility of flexure in the work. Finally, in a machine such as that illustrated, in which the bed covers a floor area measuring 41ft. in length by 12ft. in width, it is highly desirable that all controls should be centralised at one convenient point.

The main bed of the machine illustrated is a single casting provided with ways on which slides the carriage supporting the grinding wheel head. The

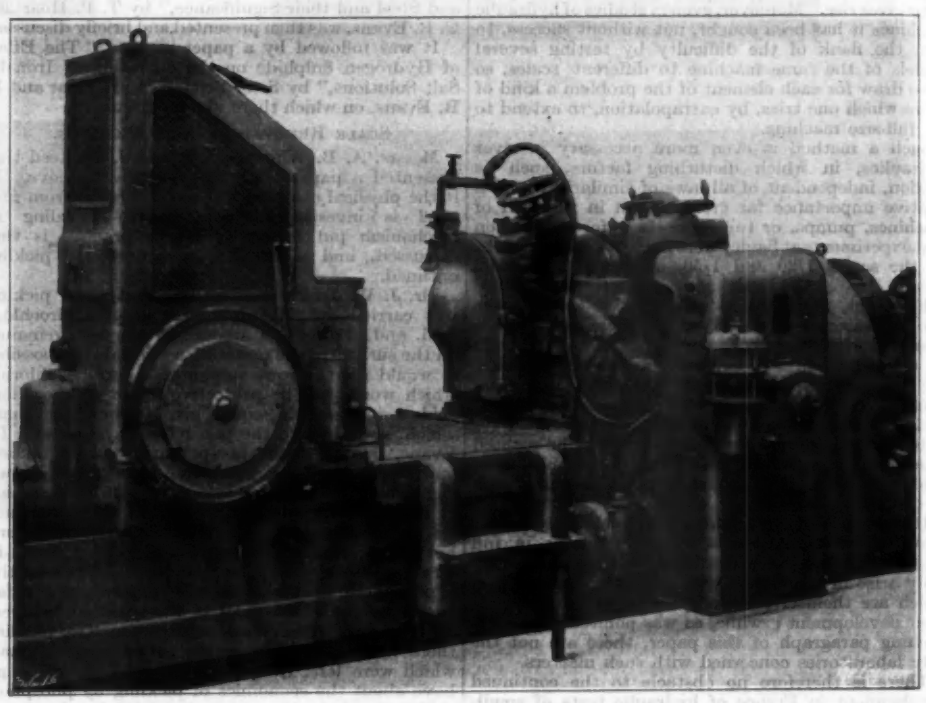


FIG. 1—WHEEL CARRIAGE OF NAXOS ROLL GRINDER

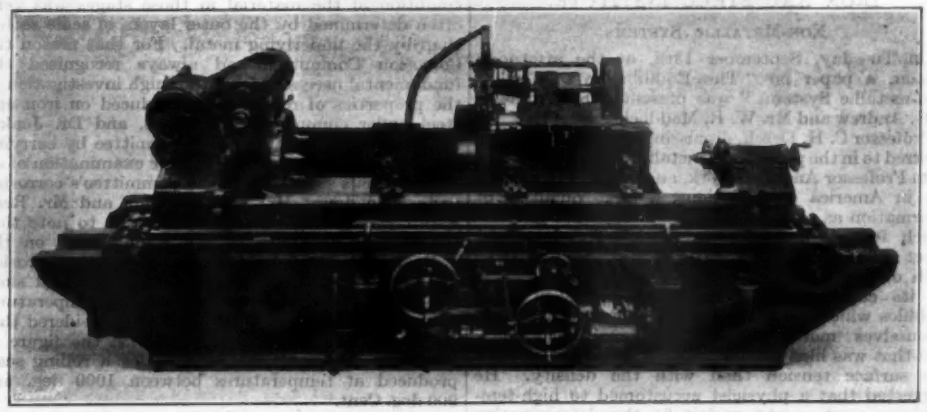


FIG. 2—CHURCHILL PLAIN GRINDING MACHINE

* No. I appeared September 23rd.

ways are covered with waterproof blinds to protect them from dust and grit. A triangular sectioned table mounted on top of the bed can be set parallel with or inclined to the grinding head ways. This table carries a fixed headstock at one end, and a sliding tail stock at the other, while intermediately a number of adjustable work stays or supports are attached to it. The triangular section of the table is claimed to give increased rigidity against the thrust of the cut. Each work stay is equipped with two blocks or pads, which are separately adjustable by means of a pair of hand wheels. Ten changes of speed are available for the rotation of the work. They range from 2·86 to 31·2 r.p.m., and are obtained by means of change gearing on the driving headstock.

Attached to the grinding head carriage and additionally supported on a separate girder there is a platform on which the operator stands and travels

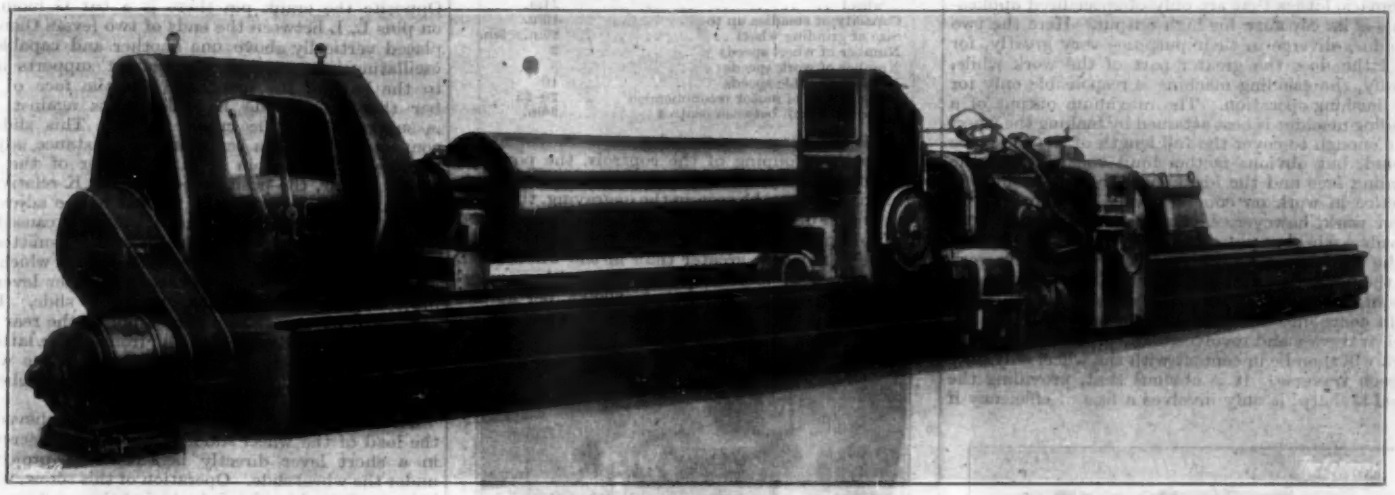


FIG. 3—NAXOS-UNION ROLL GRINDING MACHINE

with the head during the progress of the operations. The grinding head, carriage, and platform can be traversed along the bed at any one of ten speeds, varying from 2·83in. to 68·4in. per minute, while, in addition, a rapid traverse at the rate of 11ft. 6in. can be applied in either direction Adjustable stops are provided to reverse the longitudinal motion at either end of the traverse. At each reversal of the longitudinal motion a cross feed is automatically applied to the grinding head. This feed may be anything in amount from 0·0005in. to 0·005in. in nine steps. The wheel may also be fed to depth by hand, a micrometer scale being provided to facilitate accuracy in its adjustment The abrasive wheel can be rotated at either of two speeds, namely, 827 and 890 r.p.m.

The machine is driven by a motor of 35 H.P., running at a constant speed of 960 r.p.m., and placed

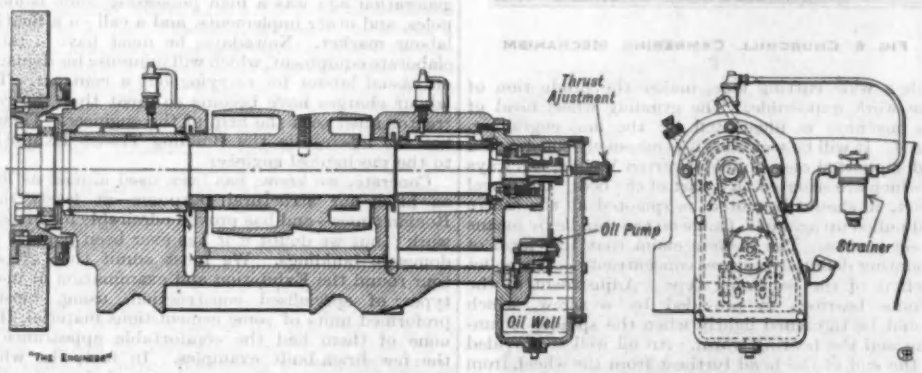


FIG. 4—WHEELHEAD OF CHURCHILL GRINDER

near the bed at the headstock end. Power for the various motions is taken from the motor through reduction gearing and belts. A main driving shaft extends along the full length of the front of the bed. From this shaft belts transmit the power to the work head spindle, to the abrasive wheel spindle, and to the carriage. The driving pulley transmitting power to the grinding wheel and carriage slides along the main driving shaft on roller bearing frictionless keys. Two adjustable brackets mounted on rollers are provided to support the main driving shaft. They are moved along by the carriage and are automatically tripped at a central point. For the purpose of truing up the face of the abrasive wheel a fitment carrying a diamond can be affixed to the top shear of the inclined table face. The cut is taken on the periphery of the wheel as it is fed slowly past the diamond. For truing up the sides of the wheel a diamond fitment is attached to the barrel of the tailstock.

When this machine had been erected in the maker's works—naturally enough without any special foundations having been laid—it was tested upon a roll, 21in. in diameter and 10ft. long, of nickel chrome steel. We are informed by the makers that the roll could be reduced at the rate of 0·008in. per hour, the grinding wheel speed being 5500 and the work speed 115 linear feet per minute, and the traverse 2in per revolution. Assuming the reasonable figure of $^1/_{32}$in. to be removed to true up the roll, four hours would be required for rough grinding, so that the whole operation complete with finish grinding could be performed in five hours.

Another large roll grinding machine is illustrated in Figs. 1 and 3. It is made by the firm of Naxos-Union, of Frankfort, Germany. The photograph reproduced on this page gives some idea of the size of this tool, which can take rolls up to 40 tons in weight, 10,000 mm. long, and 1200 mm. in diameter (approximately 33ft. by 4ft.). Considerable interest attaches to the methods of driving the roll preferred by the makers. Besides the ordinary direct gear drive, which the Naxos-Union designers consider is only suitable for rough and semi-finish grinding, another by noiseless chain is provided for finishing and polishing. These two drives are situated between the headstock face-plate and the gear-box, their ratios are exactly the same, and the change-over can be made by the movement of a hand lever. The driving motor of the headstock can be mounted in either of two ways. As illustrated, it is shown on the floor and driving the headstock through a multiple V belt, but alternatively it may be attached to the end of the bed. In the latter case a magnetic coupling is interposed between it and the gear-box, and it is claimed for this second arrangement that a certain degree of flexibility or elasticity is given to the drive, so that should the roll tend to stick in the steadies it will not be marked by the grinding wheel. Preference is given to D.C. motors on account of the possible variable speed characteristics available, but the gear-box in the headstock provides five speeds from 5 r.p.m. to 50 r.p.m. even if a constant speed A.C. motor is used. The motor should be capable of a continuous output of 25 H.P. and is controlled from the grinding head slide. In order to accommodate various lengths of roll the tailstock is movable along the bed. When fixing it in the desired position use is made of the rack of the rack and pinion driving mechanism, a pawl being dropped into mesh to lock it in position. Its spindle is carried in a long bearing and is adjustable to suit small variations in the lengths of rolls.

Nearly all the controls of the machine are situated on the grinding wheel carriage—see Fig. 1—which travels along the bed on one V and one flat guide. It is driven by a 3 H.P. motor through a rack and pinion mechanism at any of nine different speeds ranging from 115 mm. to 1650 mm. per minute (4½in. to 65in.), and a rapid power traverse is also available. The motion can be reversed either automatically or by hand. The automatic feed of the grinding wheel is hydraulic and a hand fine adjustment is obtained from press buttons, the minimum movement of the wheel being 0·0025 mm.=0·0001in. Coarse movements of the wheel for bringing it up to the work and taking a roughing cut are obtained by the use of a hand wheel for small distances or of the power traverse driven by a 1½ H.P. motor if the change in the diameter of the work is considerable. If required, a "sizing" stop can be fitted to the automatic feed. The grinding wheel itself is centred upon a taper and held in a balancing collet. It is 700 mm. in diameter by 80 mm. wide—about 28in. by 3¼in.—and its spindle is driven by a 30 H.P. motor mounted on the grinding carriage and driving by belt through a countershaft. The use of a variable-speed D.C. motor is recommended, but if an A.C. machine is installed stepped or otherwise variable pulleys are fitted in the drive so that compensation can be made for variation of the wheel diameter caused by wear. In order that the power capacity of the motor shall be fully utilised for roughing cuts an ammeter is mounted on the grinding head in full view of the operator. Cam plates, one for crowning and the other for hollow grinding, are fitted to the grinding spindle head. For generating cambered rolls the grinding wheel spindle is mounted excentrically on trunnions which are rotated slightly by an arm engaging with the cam plates.

ACCURACY.

Although the early grinding machines were built very much in accordance with the design of the lathes of that date and were used rather as machines capable of giving a better finish than the lathe, it early became recognised that the possibilities of such tools covered a sphere not directly competitive with that of the lathe. It is not so much that the grinding machine can easily surpass the lathe in accuracy—although this fact has considerable influence on the design of the machine—as that such tools can finish work to that high degree of perfection far more rapidly and easily than the lathe. In effect the grinding machine is not only an instrument of great accuracy, but also a tool capable of high production. Both these factors must be taken into account in a well-designed machine. Accuracy in every part is, of course, the first essential, since high production is of no use if it involves subsequent rejection of the product. The need for this degree of perfection has led to many modifications from the original pseudo-lathe design, since the machine must not only be accurately constructed when it is despatched from the maker's works, but it must be capable of maintaining a very high degree of accuracy through many years of service. It is common knowledge that lathe beds are subject to appreciable wear in that region which the saddle most frequently traverses. Unless this wear is of a very serious nature it does not necessarily cause the machine to be thrown out of use, since it may still be capable of giving good service where the work it has to perform need not be of the highest accuracy. On the grinding machine, however—excepting those used entirely for rough work, which do not come within the scope of this article—every job is a precision one and the presence of the slightest uneven wear of the ways upon which the table runs is repeated in the product. Consequently it is usual to find grinding machines designed with long tables and long beds, since thereby not only is the wear at any point reduced, but also that it is distributed over a great length.

In distinction again to the lathe it may be remarked that although very satisfactory machines may be made in which the wheel traverses along the work as the tool traverses along the bed of a lathe, most makers have found it advantageous to keep the position of the wheel fixed and traverse the work. In this way it is claimed the mounting of the wheel may be made more rigid and greater accuracy be

obtained. As far as many other details are concerned, it might be suggested that they are lathe mechanisms refined to greater accuracy. To a certain extent that is true. The mechanism that feeds in the wheel against the work is much the same as that which feeds in the tool of the lathe, but whereas the hand wheel of the latter is graduated to one-thousandths, that of the grinding machine is frequently equipped with a micrometer to read to an accuracy ten times as great. The comparison might be carried to much greater lengths, to the functions of steady rests on the two machines, the methods of drive, of lubrication, and in nearly every instance it would be found that, however great the accuracy of the lathe, that of the parts for the grinding machine would be greater.

Width of Wheel.

The other point that differentiates the grinding machine from the lathe—as distinct from various automatic lathes that are only of specialised application—is its capacity for high output. Here the two machines diverge in their purposes very greatly, for the lathe does the greater part of the work while, usually, the grinding machine is responsible only for the finishing operation. The maximum output of a grinding machine is best attained by making the wheel wide enough to cover the full length of the job to be ground, but obvious factors limit the width of the grinding face and the ideal can only be obtained in practice in work on comparatively small parts. In larger work, however, it is also advantageous to use as wide a wheel as possible consistent with the design of the machine. The traverse and speed of the work are then so adjusted that a point on the work that is in contact with the edge of the wheel at one side will again come into contact near the other edge as the work traverses and revolves. The greater part of the work will then be in contact with the wheel only once in each traverse. It is obvious that, providing the wheel is sharp, it only involves a loss of efficiency if

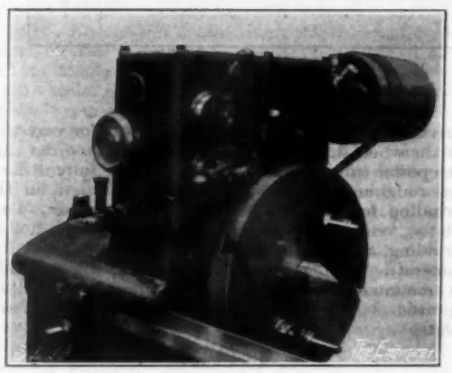


FIG. 5—WORKHEAD OF PLAIN GRINDER

any point comes into contact with the work more than once, while it is equally obvious that under these conditions the wider the wheel the more rapid may each traverse be, and consequently the greater the productive capacity of the machine. Such an arrangement of speed and traverse also has the advantage that the wear of the wheel is distributed more evenly across its whole face.

The width of the wheel is not the only consideration bearing upon the productive powers of the machine. It has already been pointed out that the rate of production depends upon the accuracy of construction. Other factors entering into the matter are the choice of speeds available, the arangement of the controls, and the rigidity of the construction. In the majority of modern grinding machines these factors are all that may be desired.

Steadies.

Whereas on a lathe the use of steadies is confined rather to work pieces, long in proportion to their diameter, steadies are a part and parcel of a grinding machine being used on all but the simplest work, and their design is of very considerable importance. The Norton Company, of America, recommends a steady with two shoes, each of which is curved to suit the finished diameter of the work. One is set against the outer side of the work rather below the centre line, and supports it against the pressure of the wheel. The other shoe is placed below the work and as near as possible to the wheel. The advantages claimed for this arrangement are that the movement of the work, caused by departures from the truly cylindrical, is in a direction that has little or no effect upon the final result of the grinding operation. Simple steadies holding the work up against the wheel, it is stated, tend to accentuate the irregularities.

Wood, bronze and hardened steel may be used for steady rest shoes. The Norton Company prefers the latter, as a general rule, on the ground that softer materials may pick up dirt and grit and mar the work, while wear is so rapid that constant adjustments must be made. Other manufacturers, however, hold different views, and many steadies are equipped with wooden shoes which may be changed or replaced rapidly at the will of the operator.

General Purpose External Grinder.

As an example of an excellent design the tool illustrated in Fig. 2 and made by the Churchill Machine Tool Company, Ltd., of Broadheath, near Manchester, may be taken. It is of a type and size suitable for a wide variety of external grinding operations. Although the principles upon which it is constructed are the same, the machine is distinctively different from the large roll grinders which we have just described, for whereas they are designed specially for work upon the largest rolls, this one is not so limited. It is one of a series of machines of different sizes—made with minor modifications—to similar designs. Its general dimensions are given in the following table.

Maximum swing over table	24in.
Maximum diameter ground with full-size wheel	24in.
Capacity of steadies up to	10in.
Size of grinding wheel	26in. × 3in.
Number of wheel speeds	2
Number of work speeds	8
Number of table speeds	10
Horse-power of motor recommended	20–25
Grinding length between centres	96in.

It will grind taper up to 8 deg.

While the grouping of the controls, the positions of the motors, and the main constructional features of the machine can be seen in the engraving, there are several other details that deserve mention. The need for absolute stability in all the parts of a grinding machine is nowhere greater than in the wheel head. The presence of any vibration even with a wheel running at a surface speed up to 6000ft. per minute

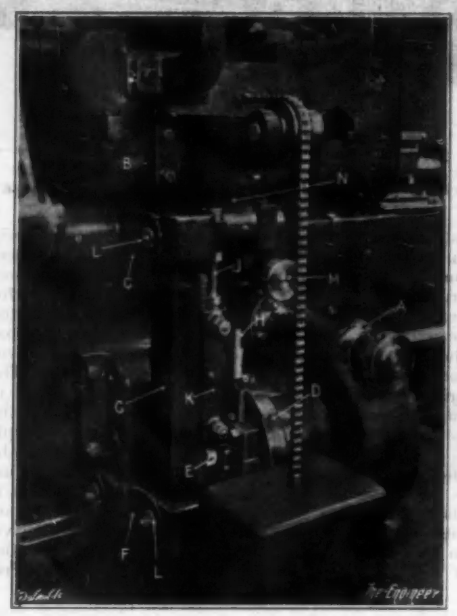


FIG. 6—CHURCHILL CAMBERING MECHANISM

with a wide cutting face, makes the production of true work impossible. The grinding wheel head of the machine is illustrated by the line engraving, Fig. 4. It will be seen that it is massively constructed and supported on a double inverted V slide, the ways of which are situated on a part of the bed. The wheel collet, it should be noted, is spigoted at the centre and pulled up against a flange on the spindle by means of set screws. The makers claim that this form of mounting definitely ensures concentricity. The collet itself is of the balancing type. Adjustment of the spindle bearings is provided by a screw, which should be tightened lightly when the spindle is running and the bearing warm. An oil well is provided at the end of the head furthest from the wheel, from which the oil is pumped through sight feed lubricators to each bearing, returning thence to the sump. The ratchet wheel feed to the wheel situated at the front of the machine is capable of giving an automatic feed at each reversal of the table of as little as 0·00025in., or as much as 0·004in. A quick hand motion is also fitted and there is a dead stop for accurate sizing.

The work table is arranged to swivel on a hardened central stud and may be set at an angle to the ways for taper grinding, the adjustment being made by a screw at the end of the table. A scale is mounted at this point with an indicator showing both in degrees, in inches per foot and in millimetres per metre the taper to which the table is set. The travel of the table is adjusted by means of hardened steel dogs on the front, which operate against the reversing lever. A tumbler type gear-box on the front of the machine provides a range of ten traverse speeds. The gears are all hardened and ground. The workhead of the machine is shown in Fig. 5. It is of the dead spindle type, the face plate being arranged to rotate about the spindle nose on large diameter ball journal bearings. The gear-box provides eight speeds, ranging from 12·8 r.p.m. to 131 r.p.m., and the one required is selected by the use of the three levers to be seen on the front of the gear-box. The final drive from the gear-box passes through a worm and worm wheel.

On the larger machines of the type just described it is possible to perform the grinding of large rolls. For this purpose the special cambering mechanism illustrated in Fig. 6 is fitted. No camber bar is used. The motion for operating the mechanism is derived from the bull wheel shaft of the traverse mechanism. The driving shaft of the mechanism projects out of the back of the base to operate a worm A and worm wheel. To the latter is connected a crank disc D to which only a partial rotating motion is imparted, even on full traverse strokes. A saddle carrying a crank pin E is mounted on the face of the crank disc, and its excentricity can be varied by traversing it across the disc by an adjusting screw H. In this way the throw of the crank pin E can be altered. Opposite the crank pin there is a bar G mounted on pins L, L between the ends of two levers C and F placed vertically above one another and capable of oscillating in a vertical plane about supports fixed to the base of the machine. On the face of the bar there is a slide K which rests against and is supported by the crank pin E. This slide is connected through a screw-and-nut distance adjusting device to the pin L in the upper of the two levers. Thus, the position of the slide K relative to the bar G can be varied by the use of the adjusting screw, and the reciprocation of the slide caused by the movements of the crank pin are transmitted to the bar. Upon the same axis as that upon which the upper lever C is mounted there is another lever N, projecting inwards beneath the wheel slide. It is connected by means of a thrust pin to the rear end of the wheel head slide B. The front of the latter is mounted upon a knife edge about which the whole of the wheel head is rocked by the cambering mechanism.

The cambering mechanism may be relieved of the load of the wheel slide by the use of a screw M in a short lever directly beneath that projecting under the wheel slide. Operation of this screw, which butts against the side of the bed of the machine, lifts the bar G and relieves the crank of the weight of the slide. The operation of the mechanism should be clear from the above description. As the work is traversed past the wheel the crank pin E, according to its position relative to the disc D, either raises or lowers the bar G and, consequently, feeds the grinding wheel out or in. At the mid position of the traverse the crank pin is vertically above or below the centre of the disc D, and, consequently, the feed of the grinding wheel is reversed for the remainder of the traverse. Concave cambers are ground when the crank is below the centre of the disc, and convex cambers when it is above it.

(To be continued.)

The Building Trades Exhibition.

THE builder and decorator of little more than a generation ago was a man possessing some ladders, poles, and other implements, and a call on a floating labour market. Nowadays, he must have a fairly elaborate equipment, which will minimise his demands on casual labour for carrying out a contract. The labour charges have become so great that the contractor must seek the help of the engineer. Therein lies the interest in the Building Trades Exhibition to the mechanical engineer.

Concrete, we know, has been used almost as long as brick for structural purposes—at least, since Roman times—and has proved admirable for massive work; but we doubt if it has ever been popular for domestic buildings. We must admit that after a tour round the Exhibition and examination of many types of specialised construction, using, mostly, preformed units of some cementitious material, they none of them had the comfortable appearance of the few brick-built examples. In fact, the whole Exhibition was a strange assortment of plain, straight, building materials, and of innovations which one would not be likely to discover elsewhere.

Take, for instance, the show of Pilkington Brothers, Ltd., of St. Helens. It was of what is known as Armourplate Glass, and might interest engineers in several directions. This glass has the appearance and transparency of ordinary plate glass, but, on account of a special process of annealing, can be maltreated in a manner that no other plain glass would withstand. It can be warped through an angle of 30 deg., almost incessantly, struck a heavy blow with a hammer, and subjected to intense differences of temperature without harm. Again, should it be distressed beyond endurance, it breaks up into a mass like granulated sugar, which can be handled with impunity. We tried it. There are no splinters that might cause wounds in flying. Tests carried out by the National Physical Laboratory show that this glass will support a load about five times as great as that of ordinary plate glass before it ruptures. The deflection is, of course, correspondingly greater.

Another section of the Exhibition which attracted us was that concerned with veneering in wood. The

result is not of very intimate concern to engineers, but the machinery employed in the various processes is essentially his product. One must here emphasise the necessary discrimination between the old veneer and the modern plywood. The former was devised essentially to ornament a base wood by thin layers of a more valuable wood glued on to the surface; while the latter is a means of producing a very tough board by crossing the grain of layers peeled off the circumference of a rotating log. In making a true veneer the thin slice of wood, only about $\frac{1}{10}$in. thick, is cut from the log, either by very fine saws or by slicing it off in a machine, much after the fashion of a guillotine. Some guillotines work vertically, and are favoured in America, but here a horizontal action is preferred. For decorative purposes the pieces of veneer are assembled in various forms, so that the figuring of the wood either blends or contrasts, and is then applied to the base and glued thereon.

For the purpose of assembly, an ingenious machine, which we illustrate in Fig. 1, has been evolved on the Continent, and was exhibited by Interwood, Ltd., of 326, Old-street, London, E.C.1.

The pieces to be assembled are laid out on a table, with their edges cut straight and bearing on opposite sides of a thin fence. The fence represents the joint which is to be made between the edges of the pieces. They are pushed forward and come between some overhead, spring-pressed rollers, and a feed chain beneath. This chain has the peculiarity that it is

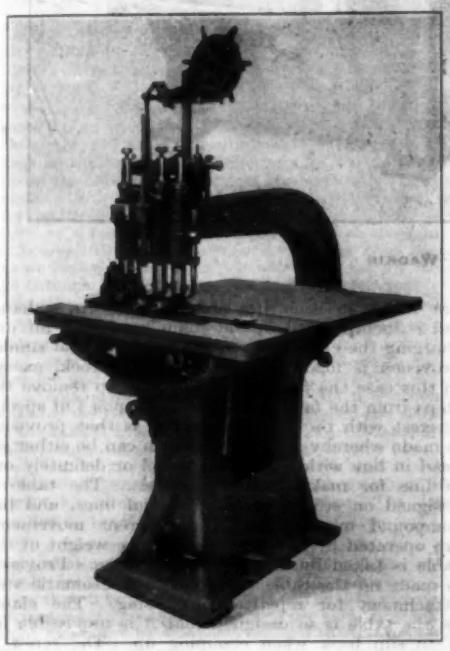


FIG. 1—VENEER TAPING MACHINE

split longitudinally and runs in a groove in the table, which gradually contracts in width from the feeding-in end to the outlet. The result is that the two sides of the chain are gradually drawn together, and with them the two pieces of veneer, so soon as they have passed the end of the fence. When they are firmly pressed together a strip of gummed paper is fed on to the joint from above, and is ironed down by an electrically heated roller, so that it forms a butt strap. The veneer having been assembled is placed on the base wood, which has been coated with glue by being passed under a fluted roller. The assembly is then put in a hydraulic press, which may have half a dozen platens, to accommodate a corresponding number of slabs, and is subjected to considerable pressure. The platens are provided with pipe coils through which either steam for heating or water for cooling can be circulated, so that the setting of the glue can be accelerated. When the veneer has been safely glued on to the base, the paper butt-strap is torn off and the surface finished, the attachment to the base being sufficient to keep the joint almost invisible.

Another side of decoration, in which the engineer provides a large part of the necessary plant, that was well represented at the Exhibition is the making of paint. Torrance and Sons, Ltd., of Bitton, near Bristol, showed a number of their roll paint-grinding machines, with the micrometer adjustment for the clearance of the rolls, which we have already described, together with several mixing machines, but they are sufficiently familiar to our readers to need no further description. Sidney Smith, of 58, Quadrant House, Pall Mall, S.W.1, also exhibited a number of typical paint-making machines; and Marchant Brothers, Ltd., of Verney-road, London, S.E.16, showed, among other paint machines, the disc grinding mill illustrated in Fig. 2.

This mill, it will be seen, is of the horizontal spindle type, with a rotary disc operating in conjunction with a disc fixed to the casing. The paint is fed in between the discs, is thrown out through a very narrow opening by centrifugal force, and is thoroughly ground in the process. The discs are made of very hard steel and have their faces ground to a mirror-like polish. The fixed disc can be adjusted to determine the opening for the passage of the paint by means of fine-pitch screws with micrometer heads. This disc is also arranged for water cooling. It will be noticed that the casing is mounted on long-stemmed studs so that it can be easily drawn back for cleaning purposes. The mill is made in two sizes with discs 9in. and 16in. in diameter, with capacities of 30 and 60 gallons per hour, respectively.

There were, naturally, quite a number of concrete mixers in the Exhibition. John Fowler and Co., of Leeds, for instance, had three, one driven by an electric motor, one by a heavy-oil engine, and the other characterised by the fact that it has a "dimpled"

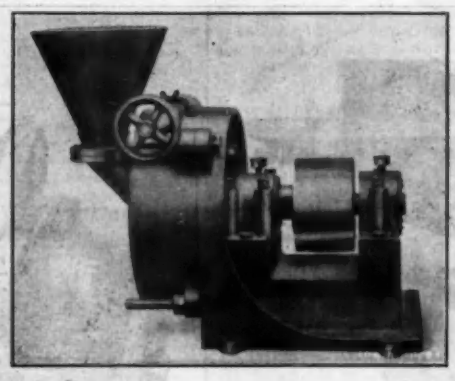


FIG. 2—PAINT MILL—MARCHANT

drum to prevent balling of the mix. On this stand there was also a hoist and steel mast equipped with a tipping skip. The Liner Concrete Machinery Company, of Glasshouse Bridge, City-road, Newcastle-on-Tyne, had a small tilting drum mixer, driven by a 1½ H.P. petrol engine, and two roller pan mixers of 4ft. 6in. and 3ft. 6in. diameter, respectively. Millars' Machinery Company, Ltd., of Pinner's Hall, Great Winchester-street, London, E.C.2, displayed three mixers of the tilting drum type, all driven by petrol engines, having outputs ranging from 15 to 45 cubic yards per eight-hour day, together with a roller pan mixer having heavy spring-loaded rollers revolving in a fixed pan, 4ft. 6in. in diameter. Frederick Parker, Ltd., of Catherine-street (Extension), Leicester, showed quite a number of mixers, all driven by Lister petrol engines, a roller pan mixer, and other concrete-making machinery.

Among the concrete mixers exhibited by Ransomes and Rapier, Ltd., of Ipswich, there was the one illustrated by Figs. 3 and 4. It has a capacity of 6 cubic feet of unmixed materials, or about 6 cubic yards of concrete per hour. The novel feature about

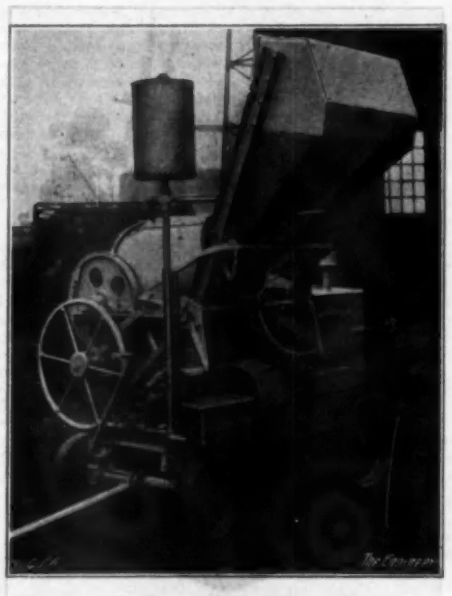


FIG. 3—CONCRETE MIXER—R. AND R.

this machine is that it has no overhead framing for the hoisting of the skip, so that it can be run underneath a low scaffolding. The arrangement also has the advantage that the centre of gravity is kept low. The hoisting is effected by wrapping the hoisting rope round two quadrants on opposite ends of a shaft, which also forms the pivot round which the skip swivels. The ropes are attached to these quadrants and to the framing of the skip, so that by rotating the quadrants the skip is raised. There is an automatic knock-out which prevents the skip being overwound. The drum is 2ft. 9in. in diameter by 2ft. 7in. deep, with an opening 1ft. 7in. in diameter. It runs at 19 r.p.m. and is driven, through a Hans Renold roller chain, by a 3 H.P. four-stroke Lister hopper-cooled engine running at 600 r.p.m. The engine is totally enclosed in a steel casing. It is said that this machine can be run on a fuel consumption of approximately 1½ gallons a day.

Stothert and Pitt, of Bath, had as many as seven mixers, of both the tilting and fixed drum types, with capacities of from 3½ up to 10 cubic feet and all driven by Lister petrol engines. The drums are made of steel with pressed ends and are electrically welded together, and the toothed driving ring is so arranged that it can be easily replaced when worn. Ball bearings are fitted to the shafting and they are lubricated by the grease-gun method. In the case of the larger machines the engine is of 7 H.P. and is cooled by means of a radiator. An automatic water tank is

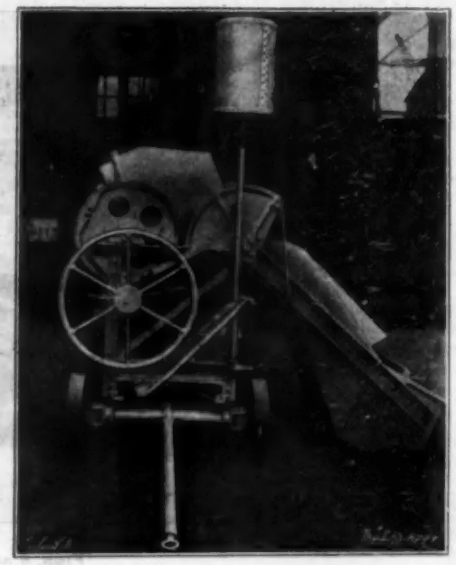


FIG. 4—CONCRETE MIXER—R. AND R.

provided, with an adjustable syphon whereby any amount of water up to 12 gallons can be added to the batch. It is fitted with a gauge glass. The travelling wheels of this machine are fitted on swivelling stub axles, so that it can travel in any direction.

A novel feature on the stand of the Expanded Metal Company, Ltd., Burwood House, Caxton-street, London, S.W.1, was a model of a new form of flooring designed by Sir Edwin Airey, of Wm. Airey and Son, Ltd., of Leeds, of which we give some

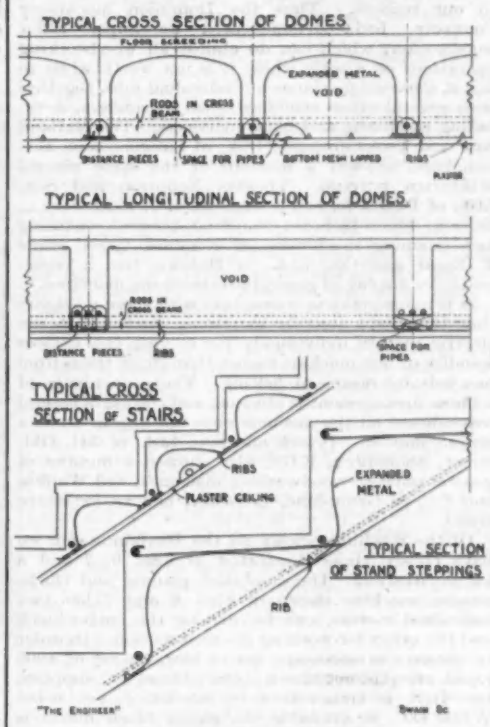
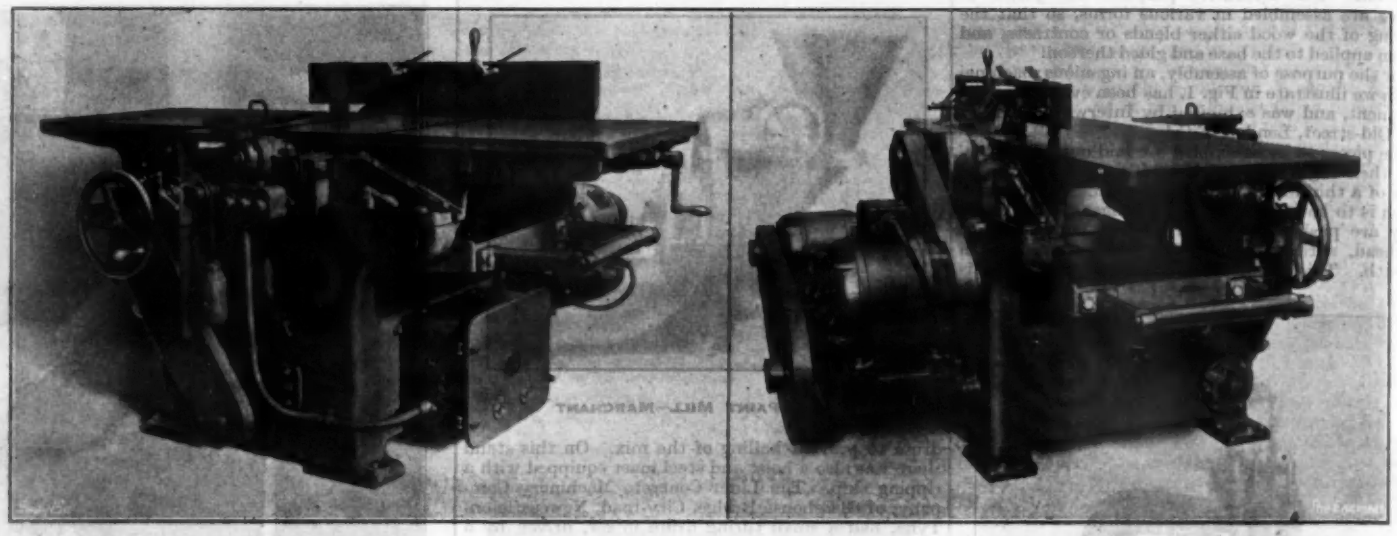


FIG. 5—CONCRETE FLOORING

drawings in Fig. 5. The idea is to use galvanised expanded metal to form arches, or domes as the inventor calls them, to act as reinforcement and shuttering for the concrete. The domes have a flange round all four sides and are put in place between the main girders, supported on an open trestle arrangement. There are, consequently, continuous valleys between the domes, both longitudinally and transversely of the span. In these valleys the reinforcing rods are laid and the concrete is then poured straight on to the assembly and screeded off. It penetrates the openings in the expanded metal, with which it makes a thorough bond, but it does not drop

through. The result is that the valleys form reinforced concrete girders, bridged over with a light but strong arch, and spans as great as 30ft. can be safely adopted. The bottom, or floor, of the domes may be used as lathing for a plaster ceiling, or it may be omitted and the lower face finished with a cement gun, as it does not add appreciably to the strength of the floor. The domes are made by the Expanded Metal Company and may be of any size. The drawing also shows a staircase made on the same general principles.

A novel form of illuminated guard post for guiding traffic in roadways was exhibitied by the Cardiff Foundry and Engineering Company, Ltd., of Hurman-



FIGS. 6 AND 7—COMBINED PLANING AND THICKNESSING MACHINE—WADKIN

street, Cardiff. It is a pillar of cruciform cross section with a spreading base and a hood, or cap, at the top. It is painted in brilliant colours, such, for instance, as red and yellow, and stands out very conspicuously in the daytime. At night it is illuminated by electric lamps in the cap, which are obscured from direct vision, but cast a brilliant light downwards on to the painted surfaces. The pillar is easily kept clean and is very strong to withstand accidental collision.

Woodworking machinery was well represented in that part of the main hall which used to be known as the annexe, but the majority of the machines are familiar to our readers. Thus the Dominion Machinery Company, Ltd., demonstrated its Super Elliot woodworker, which can do almost all woodworking operations on a scale where it is not worth while to put in separate machines for individual jobs, together with several other machines, such as sanders, dovetailing machines, and hand morticers. The Midland Saw and Tool Company, Ltd., of Summer-lane, Birmingham, showed a machine of the same general utilitarian purpose. Thomas Robinson and Son, Ltd., of Rochdale, had a large stand of machinery in motion, which included moulding, planing, surfacing and tenoning machinery of standard types, while J. Sagar and Co., Ltd., of Halifax, had a representative display of general woodworking machines.

It is noteworthy in connection with these machines that there is a steadily increasing tendency to use electric motors individually for driving the various spindles of one machine rather than drive them from one belt by means of belting. The convenience of such an arrangement is obvious, and the extra capital expenditure on the machine does not appear to be a serious matter. Tyzack and Son, Ltd., of 341, Old-street, Shoreditch, E.C.1, also showed a number of general purpose woodworking machines, and Wadkin and Co., of Green-lane, Leicester, had an extensive stand.

Of the machines shown on the Wadkin stand, we have chosen those illustrated in Figs. 6, 7 and 8 for illustration. The combined planing and thicknessing machine shown in Figs. 6 and 7 has two individual motors, one for driving the cutter-block and the other for working the feed motion. In order to obtain the necessary cutter block speed of 4000 r.p.m. when the machine is operated from A.C. supplies, the drive is transmitted by means of Vee belts. When D.C. is available the cutter block motor is coupled directly, this being made possible by the fact that the speed of the motor is not limited as in the case of A.C. The power from the feed motor on both the A.C. and D.C. machines is transmitted by Vee belts to a gear-box, which gives three alternative speeds of 20ft., 30ft. and 46ft. per minute. As will be seen from the illustration, Fig. 7, which illustrates the A.C. machine, the motors are carried on brackets bolted to the side of the gear-box, and the whole assembly is carried on the side of the machine. With the D.C. machine the cutter block is carried on a bracket forming the top of the gear-box. The surfacing tables are 6ft. long, heavily ribbed to prevent twisting and scraped dead true, so that perfect glue joints can be made. Both tables have horizontal drawing out motion for convenience in getting at the cutter block. The table edges adjacent to the cutters are fitted with steel lip plates. Both tables have raising and lowering motions, and an index scale is provided to indicate the exact amount of the vertical movement in relation to the cutter block. The thicknessing table is mounted on broad slides on each side of the main frame, and is raised and lowered to the extent of 9in. by means of screws at each side of the machine. Both screws are fitted with anti-friction ball-bearing thrust washers, and are operated by machine-cut spiral gears. The table is provided with two adjustable anti-friction rollers let into the table, and both are arranged with a small vertical adjustment. This is a new feature which greatly facilitates the handling of timber that would ordinarily bind on the table when going through the machine. The vertical adjustment on the rollers is applied simultaneously by turning a hand wheel at the feed-in end of the table. The cutter block is of the two-knife safety circular type, with a cutting circle of 5in. diameter. It revolves in heavy ball bearings.

The cutter block is designed to take moulding cutters which can be used without upsetting the ordinary planing knives. The feed rollers are driven from the variable speed gear-box by a chain totally enclosed and running in an oil bath. All the feed

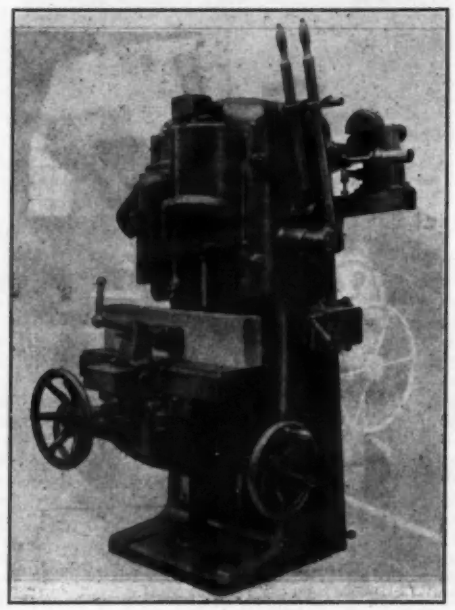


FIG. 8—MORTISER—WADKIN

gearing is of steel machine cut. The feed rollers and pressure bars are controlled by adjustable springs and provided with stops to prevent them being lifted into the cutters. When required this machine can be arranged with the front surfacing table hinged so that it can be tilted. To obtain this movement the table is pivoted at the back side, and the tilting motion is actuated by a screw and nut let into the surface of the table at the front side. A scale is fitted to indicate the amount of taper obtained.

An entirely different application of the electric drive has been adopted in the case of the combined chain and chisel mortiser which is illustrated in Fig. 8.

Both chain and chisel headstocks of this machine incorporate built-in electric motors with the rotor of each mounted directly on the mortising spindles. The chain motor is rated at 4 H.P. and the chisel motor at 2 H.P. In order to ensure that the cutting tools automatically start and stop before and after making the mortise, the motors are controlled simultaneously with the sliding motion of the headstocks, by the headstock hand levers. The actual starting and stopping of the motors is effected by the headstocks operating a switch which opens and closes the main contactor. The control gear is by the Brookhirst Company, and the contactor is totally enclosed and provided with overload releases. Both headstocks are counterbalanced and depth stops are fitted to each headstock slide. An exhaust fan is incorporated in the chain headstock for discharging the chips clear of the machine, and similar provision is made on the chisel headstock, except in this case the fan acts as a blower to remove the chips from the face of the work. A point of special interest with the chain headstock is that provision is made whereby the mortise chain can be either set dead in line with the hollow chisel or definitely out of line for making offset mortises. The table is designed on sturdy and substantial lines, and has compound movements. The different movements are operated by hand wheels and the weight of the table is taken by a ball thrust bearing. Provision is made on the table for taking an automatic stop attachment for repetition mortising. The clamp on the table is so designed that it is impossible for it to slip back when clamping up. The screw is arranged at an angle, and the tendency is, therefore, to press the timber downwards on to the table. A minor improvement is the fitting of a check rod to prevent the clamp from swinging out of parallel.

BOOKS OF REFERENCE.

The Roadway Goods Transport Guide for Great Britain, 1932–33. London: Roadway Publications, Ltd., Polebrook House, Golden-square, W.1. Price 12s. 6d. net.—The second edition of this guide has been completely re-edited and rearranged, and users will find that information is concise and readily found. The arrangement is geographical, with the names of towns placed in alphabetical order. Under each name is given the name of the local carriers, the areas they serve, the classes of haulage undertaken, and the number and capacity of available vehicles. To producers, manufacturers, and traders using road haulage for the transport of their goods the new edition will be an invaluable directory of the motor haulage industry.

Universal Directory of Railway Officials, 1932. London: Directory Publishing Company, Ltd., 33, Tothill-street, S.W.1. Price £1 net.—The thirty-eighth edition of this directory follows the same lines as the previous issue, and the publishers state that great care has been taken in entering the changes in *personnel* of home and foreign railways. We are sure the information it contains will be found as comprehensive and accurate as before.

The Railway Year-Book, 1932. London: The *Railway Magazine*, 33, Tothill-street, S.W.1. Price 5s. net.—All connected with the railway world are well acquainted with this valuable year-book, and there is little for us to say except that the information it contains is as complete and up to date as in previous years.

THE Cork, Blackrock and Passage Railway has been closed. It was one of the four small railways having termini in Cork and was opened, on the standard Irish gauge of 5ft. 3in., in 1850. When the Crosshaven extension was being built the gauge was changed to 3ft., as that was to be the dimensions of the new line. The latter was opened in 1904.

Railway and Road Matters.

WHEN the work of reconstructing the Southern Railway station in Exeter is completed it will be known as Exeter Central instead of Exeter, Queen-street.

THE date for the opening of the twelfth session of the International Railway Congress, which is to meet in Cairo, has been provisionally fixed for January 16th next.

FROM an article entitled "The Estate Office," in the September issue of the *Southern Railway Magazine*, it appears that that company has 13,000 allotment tenants and 41,000 other persons from whom rent is collected. The company owns 6993 houses and lets 3030 arches.

IN pre-war days the 4 p.m. service from Paris was due at Charing Cross at 10.45 p.m. It is now due at Victoria at 10.50, but from October 2nd it will leave Paris at 4.40 p.m. and be due Victoria at 11.5 p.m. This gives a useful extra forty minutes in Paris with only fifteen minutes later arrival in London.

IT is not without interest to recall, in connection with the opening on September 19th of a portion of the northern extension of the Piccadilly Railway, that when the Bill was before Parliament in 1930 the London and North-Eastern intervened with a scheme for an extensive electrification of its lines in the London area. That was offered as an alternative to the tube extension, but the Bill for the latter was passed.

THE Egyptian State Railways have appointed the following gentlemen to represent them at the twelfth Railway Congress which will be held in Cairo next February :—Hamdy Bey Khattan, Chief Engineer; Mr. G. Macaldin, Deputy Chief Engineer; Mr. W. D. Knight, Deputy Chief Mechanical Engineer; Abdel Rahman Bey Hamada, Assistant Chief Mechanical Engineer; Mr. P. Weaver, Traffic Manager; Hussein Effi. Sayed, Government Delegate for Ramleh Tramways.

WE reported herein on February 19th last, with much satisfaction, that the railways of the United States and their men had agreed to a voluntary reduction of 10 per cent. in their pay on condition that the companies would do all they could to maintain and increase railway employment. Cable advices state that the railways now seek for further reductions and these the men will resist, partly because the companies have not kept their bargain. A difficult situation for the employers will now arise, because, as we remarked on January 8th last, the case will have to go through the long procedure of the Wages Boards and may then be rejected.

Two further railway pooling schemes have now been submitted to the Minister of Transport for his approval, and, as with the London, Midland and Scottish and the London and North-Eastern proposals, have been referred to a committee for consideration. The new scheme is that for the L.M.S. and the Great Western, and the other is the L.M.S., L.N.E., and Great Western. The conditions laid down in the report on the earlier scheme have been accepted by the new applicants, except that the Great Western desires to be allowed to retire members at an earlier age than under existing practices. The date of hearing by the Committee will be October 31st.

THE Ministry of Transport railway statistics for June last, mentioned herein on September 16th, also gave the results for the first six months of the present year. They show that, compared with the first half of 1931, the number of passenger journeys fell by 4·0 per cent., the receipts from passengers by 7·8 per cent., and the total passenger receipts by 7·1 per cent. The tonnage of freight decreased by 5·4 per cent. and the freight receipts by 8·6 per cent. The passenger train mileage was reduced by 0·9 per cent. and the freight train mileage by 5·1 per cent. The average train load fell from 125½ to 122¾ tons, but the net ton-miles per engine-hour—speed—increased from 446¼ to 449¾.

SIX hundred motor experts and traders who visited the Humber-Hillman-Commer works at Coventry on Tuesday, September 27th, were treated to a remarkable display of speed by the L.M.S. Railway, whose special trains provided for the conveyance of the party made a series of four journeys at the highest speeds ever recorded between Euston and Coventry. Two special trains were run in each direction and were scheduled to cover the 94 miles in ninety minutes at an average speed of 62·7 m.p.h., the fastest London-Coventry timing on record; but on all four runs even this record schedule was easily eclipsed. The fastest run of all was made by "Flyer No. 2" in the down direction, which covered the 94 miles in 82 min. 42 sec., at an average speed of 68·2 m.p.h., start to stop, despite enforced speed reduction at Castlethorpe owing to engineering operations.

THE report by Lieut.-Colonel Anderson on the Wardleworth derailment of June 12th was issued on September 23rd. As related herein on June 24th, when an empty carriage train was proceeding from Rochdale to Bacup, on the London, Midland and Scottish Railway, the engine left the rails soon after passing through Wardleworth Station, and turned on its right side. The driver was killed. The train was drawn by a 2–4–2 radial tank Horwich-built engine, new in 1900. It last underwent heavy repairs in 1930, and since then it had run 63,325 miles. It was in the shops for service repairs in April of this year, and its subsequent mileage was 5298. The cause of the derailment was the breakage, close to the inner edge of the right-hand journal, of the trailing coupled axle, which was put under the engine in 1902 and had since run 784,473 miles. Colonel Anderson gives particulars of the defects that were found by the company's officers in the axle after examination, and adds that it is, indeed, remarkable that the axle had lasted so long. Its diameter at the point of fracture was 7½in., and the designed load on it was 17 tons 8 cwt. The report remarks that there are no practical means of detecting such an internal flaw under workshop conditions that existed when it was made, or, indeed, that exist to-day. The rareness of such an accident was shown by the fact that during the year 1931 there were reported in the whole country only six breakages of leading or trailing engine axles, which fact, indeed, shows the great care bestowed on their manufacture at every stage.

Notes and Memoranda.

THE Birmingham Gas Department is making a test of a commercial motor vehicle operated by coal gas compressed to a pressure of 3000 lb. per square inch in steel bottles. The scheme has the sanction of the Home Office.

IT is proposed to utilise the Pallivasal Falls on the Mudrapuzha River, in Travancore, for hydro-electric development. The falls themselves have a height of 400ft., but a total head of about 1000ft. is available. The rainfall on the catchment area of 50 square miles is said to be 400in. per annum.

THE installation of the grid system and general adoption of alternating-current supplies will, says "Chemgineer," in the *Chemical Trade Journal*, provide an increasing demand for rectifiers of varying capacities. Selenium only just appears to be entering the market for this application, and the opportunities for chemists to give valuable service to the engineer in this branch seem at the moment exceedingly hopeful.

WOOD-TAR creosote has been examined for its timber-preserving qualities in the Forest Research Institute at Dehra Dun, in Northern India. According to the Indian correspondent of the *Timber Trades Journal*, it has been found from the toxicity tests that, as compared with coal-tar creosote, the Mysore creosote is rather superior. Wood-tar creosote is produced by the Bhadravati Iron-works, the wood distillation plant there being the only one of its kind in India and perhaps the largest in the East.

A NEW alloy known as MG7, which has been brought out by James Booth and Co., Ltd., is composed mainly of aluminium in combination with magnesium and manganese in such proportions as to produce a material having a specific gravity of only 2·63, while its mechanical properties are similar to those of duralumin. It is stated that it combines very high resistance to corrosion with high mechanical strength, and that it is not susceptible to heat treatment, variations in its strength being obtainable only by the application of different amounts of cold work.

A SYSTEM of stowing in coal mines which has been developed at the Brucher Kohlenwerke A.G., in Germany, is described in a recent issue of *Glückauf*. Loamy clay is excavated on the surface, and is converted into balls about 4in. in diameter by passing it through moulds with hemispherical indentations. The balls are dropped down a pipe in the shaft and conveyed to the workings by a current of water. At the face they are packed in place by being forcibly ejected by compressed air. The system is said to be more economical than stowage with sand and water.

AT a special general meeting of the Optical Society, held at the Imperial College of Science and Technology, South Kensington, on September 22nd, 1932, the Society was formally dissolved. This was the final step in the process of amalgamation of the Society with the Physical Society of London, which has already made the necessary changes in its constitution. The joint societies will be known as the Physical Society, and the first meeting of the new session will be held on Friday, October 7th, at 5 p.m., at the Imperial College of Science and Technology, South Kensington, when Dr. J. W. French, F. Inst. P., will lecture on "The Manufacture of Optical Glass."

THE use of chemicals, impregnated in wood to render it fire resistant, has been in practice for some years, but the present high cost of such treatments has delayed the more general use of fire retardants in structural timbers and other forms of lumber. In an effort to obtain a suitable treatment at low cost, the Forest Products Laboratories of Canada, Forest Service, Department of the Interior, are studying the fire-retardant properties of a number of chemicals. From this study it is hoped to evolve a treatment which will act as a satisfactory fire retardant, at low cost, in addition to allowing the wood to retain its natural finishing qualities and to having no harmful effect on the durability or strength of the wood.

CONTRARY to the general belief of many, recent studies of forests and stream flow duly indicate, says *Power*, that the maintenance of forests on watersheds greatly reduces the available water supply. At the recent Annual Convention of the American Society of Civil Engineers, a paper was presented by W. G. Hoyt, hydraulic engineer of the U.S. Geological Survey, and H. C. Troxell, associate hydraulic engineer of the U.S. Geological Survey. The paper gives the results of a number of years of observation and scientific study of areas in Colorado and California, and graphically shows the average annual increase in accumulated excess of run-off as a result of deforestation. Such increases of run-off from the same areas as 15·3 per cent. at Wagonwheel, Colorado, and 28·7 per cent. at Fish Creek, in the southern part of California, are reported as yearly averages, following approximately six years of study.

THE production of radium on a large scale has been in Belgian hands for about ten years, says the *Deutsche Bergwerks Zeitung*. Owing to the scarcity of radium on the one hand, and its enormous importance for medicinal and technical purposes on the other, its price has undergone fantastic fluctuations since its discovery. In the last five years before the war, growing demand drove the price of a gramme up to about £35,000 gold. But the economic production of this metal by the Belgians caused it to fall to roughly £24,000 in 1922. Since then it has steadily declined, the present quotation being about £13,000. Such a high price can, of course, only arise—apart from the actual costs of production—from a demand so overwhelming that supply cannot possibly keep up with it. Such a demand exists for radium, the present world stock of which is nearly 550 grammes, distributed among a number of countries. Of this quantity, the Belgian company has produced 350 grammes in the ten years of its existence. Germany only possesses 3 grammes. About the middle of last year it was reported that large deposits of pitch-blend (from which radium is obtained) had been discovered in Canada, but the Belgian mono poly does not yet show any signs of being broken, nor is any early reduction in the price of this scarce metal hoped for.

Miscellanea.

A NEW telephone cable is being laid between St. Margaret's Bay and La Panne, in Belgium.

COAST protection works which are projected in the vicinity of Brighton will probably cost about £97,000.

THE grain storage capacity of the port of Vancouver is to be increased from 16,228,000 to 17,703,000 bushels.

A NEW graving dock is to be built at the Wallsend-on-Tyne works of Swan, Hunter and Wigham Richardson.

THE Sandvik Dock at Helsingfors, Finland, is to be extended at a cost of about five and a-half million marks.

DURING her latest trial trip the new Italian liner "Rex," of 47,000 tons, maintained an average speed of 28·9 knots, with a maximum of 29·8 knots.

IT is said that the iron ore deposits of the Kursk region of Russia contain eighteen million tons of metallic iron. The ore bears 65 per cent. of Fe.

A BUST of Michael Faraday presented to the museum at Munich by the Institution of Electrical Engineers of London was unveiled on September 22nd.

THE Argentine Department of Navigation and Ports has been authorised to proceed with the construction of an inland port at Campania, 50 miles from Buenos Aires, on the Parana River.

THE plans for the Beauharnois project between Lakes St. Louis and St. Francis have been passed by the Canadian Government. The scheme, of which we have already given some particulars, will cost 50,000,000 dollars.

REPORTS from Afghanistan state that coal has been discovered near Kabul. This discovery will be exploited in the near future with, it is said, American capital. American help will also be sought in exploiting the oil-fields.

IN order to develop communication facilities in the southern provinces of Hunan, Kiangsi, Kwangtung, and Fukien, the Central Government of China is considering the construction of three main railways connecting the four provinces.

THE train ferry for the service across the Yangtse River in China between Nanking and Pukow, is to be launched at the yard of Swan, Hunter and Wigham Richardson on October 12th. She will go out to China under her own steam.

HITHERTO, machinery for equipping industrial plants has been allowed to enter Turkey free of import duty. Now, however, a monopoly has been created of all machinery imports, which has been vested in the Turkish Industrial Credit Bank.

THE output of dressed lead ore from the mines of Great Britain increased from 25,380 tons in 1930, to 29,502 tons in 1931, but the number of mines in operation decreased from twenty-one to fifteen. The value of the ore at the mine was £191,200.

IT has been officially confirmed by the Royal Aero Club that the altitude attained in his recent high flight by Captain Uwins was 43,976ft., or about 800ft. higher than the previous record. The climb took about two hours and resulted in a large mass of useful information concerning flight at high altitudes.

THE Shell Oil Company of Canada has begun work on the erection of a new oil refinery at Montreal, representing a capital investment of 2,000,000 dollars. The refinery is to have an initial capacity of 100,000 gallons of gasoline per day, in addition to other products. The plant will include five tanks of 4,130,000 gallons capacity each, which, it is said, are to be larger than any tanks yet built in Canada.

A VERY fine performance in the way of dry-docking has just been set up at the Gladstone Graving Dock, Liverpool. The Canadian Pacific liner "Duchess of Bedford" went into the dock at 2.50 p.m. on Tuesday for the purpose of examining her bottom. She was dried out at 6.15 p.m., was examined and afloat again at 8.35 p.m. The "Duchess of Bedford" is a vessel of about 20,000 tons.

THE construction of a new metallurgical works some 10 kiloms. from Tula, Russia, is going rapidly ahead. The works will consist of seven blast-furnaces, a coke and by-product works, Marten steel plant with an output of 850,000 tons of iron, a pipe foundry, and a power station, with an output of 50,000 kilowatts. The first blast-furnace should be in operation by January 1st, 1933, and the second by April 1st.

THE Lucknow Municipal Board has sanctioned the installation of a third pumping set, capable of discharging 10,000 gallons per minute, in order to increase the water supply. The pump, which is expected to cost about Rs. 75,000, will be ready for use during the summer of 1933. It will be recalled, says *Indian Engineering*, that in May last Lucknow was threatened with a shortage of water owing to the unsatisfactory state of the existing pumps.

PREPARATIONS have been begun for the building of a big hotel to accommodate foreign visitors in Moscow. It is situated in the Okhotnoe Ryad, opposite the hotel of the Moscow Soviet, and not far from the House of the Unions. It is to be a twelve-storied building with 800 suites of rooms. There will be a room specially devoted to the exhibition of models and plans of all the big Soviet constructional works and to supplying foreign tourists with programmes of routes. The hotel will be opened by the end of 1933.

A SCHEME whereby intending passengers by the tramways can be kept informed of the movement of trams, is, says the *British Russian Gazette*, being organised in the tram terminus outside the three main Moscow stations. A tower has been erected in which a controller will be stationed and will be able to inform passengers by means of loudspeakers fitted up by the tram stops. He is to inform the passengers of the approach of trams, the places where they will stop, their routes, and the number of places available, and will also give warning in the event of breakdowns and modifications in the service.

LARGE EXTERNAL GRINDING MACHINE

JOHN HOLROYD & CO., LTD., ROCHDALE, ENGINEERS

(*For description see page 326*).

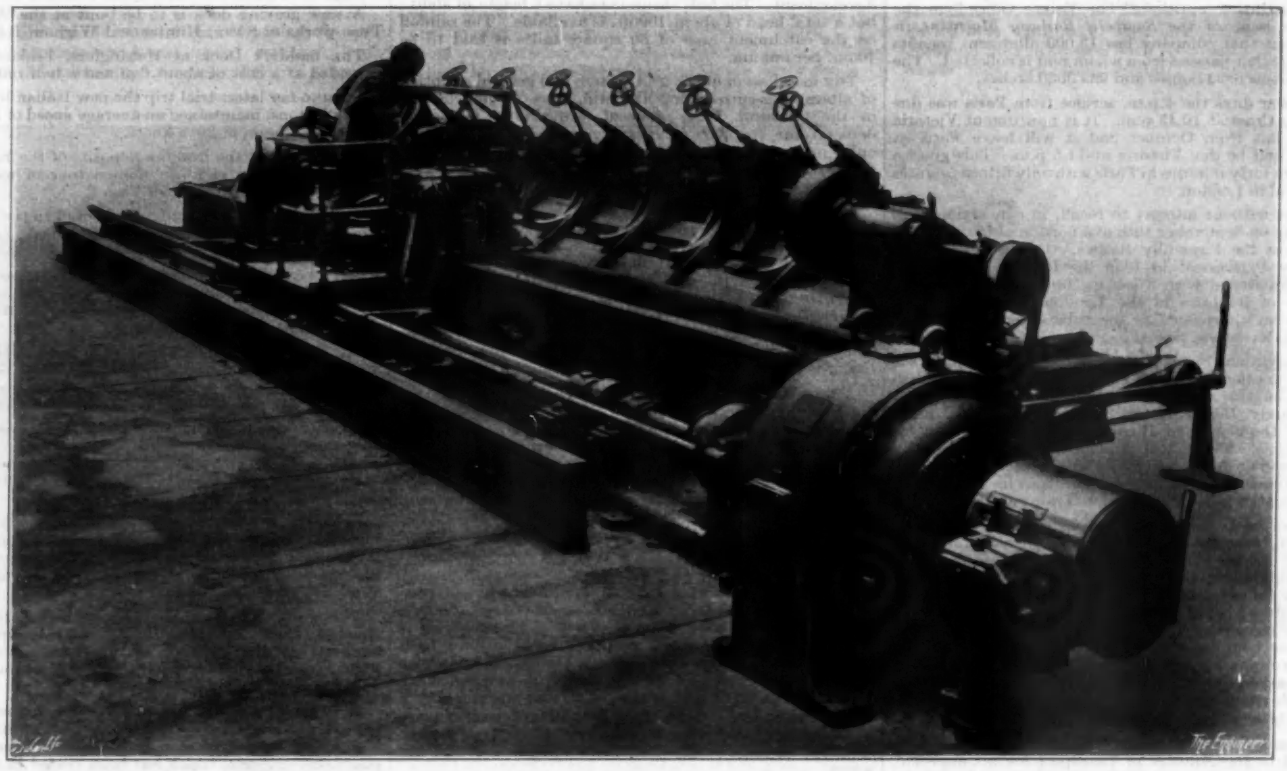


FIG. 7—VIEW FROM DRIVING END

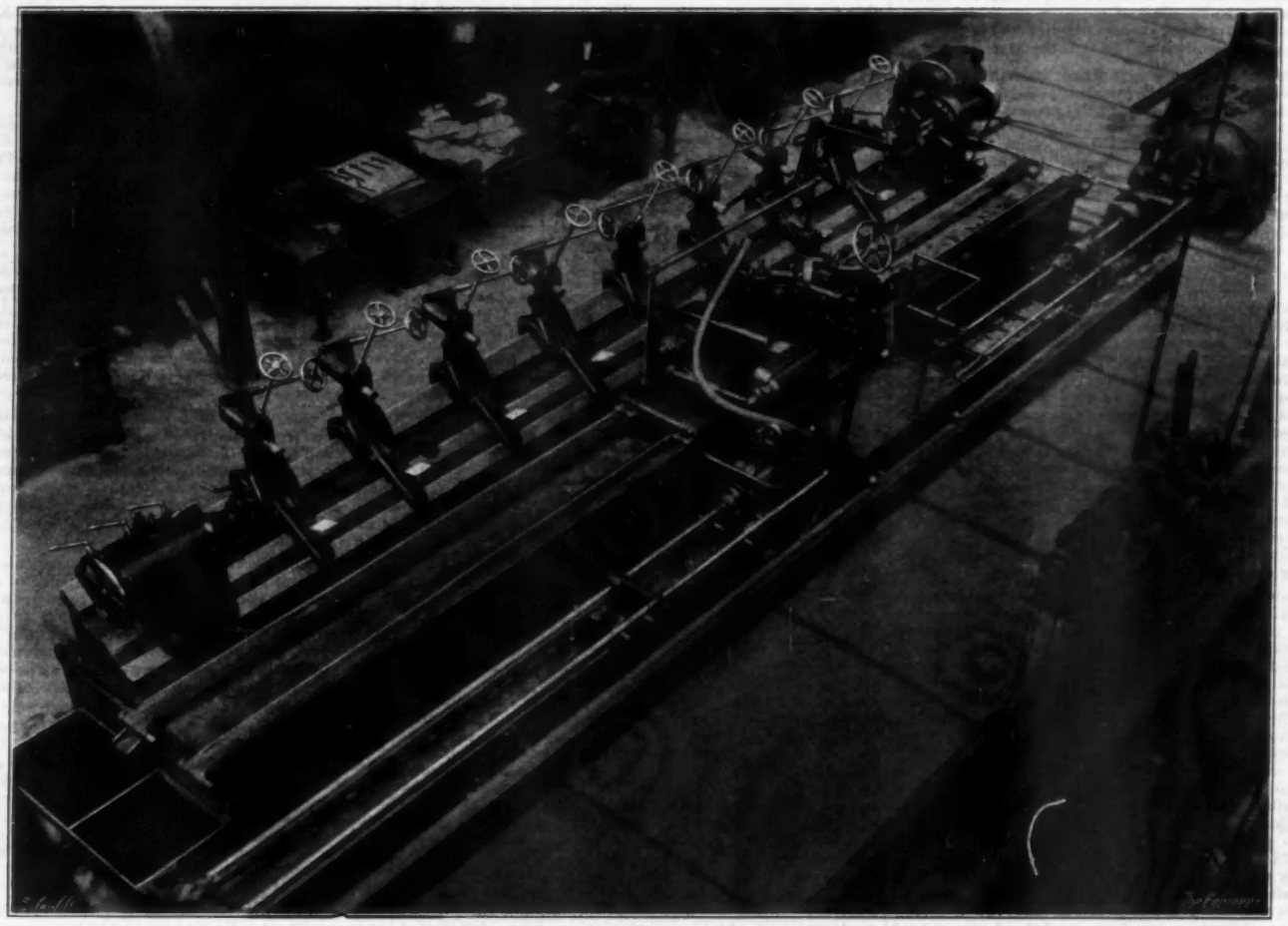


FIG. 8—GENERAL VIEW OF MACHINE

The Engineer

SEPTEMBER 30, 1932.

VOL. CLIV. No. 4003

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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

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The Metallurgist.

THE SEPTEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE CANADIAN RAILWAYS.

THE Royal Commission which has just reported on the railway systems of Canada is the second such body, within a period of sixteen years, to investigate that subject. On July 13th, 1916, Mr. A. H. Smith, the president of the New York Central; Sir Henry Drayton, the Chief Commissioner of the Canadian Board of Railway Commissioners; and Sir George Paish, editor of the *Statist*, were appointed to hold an inquiry into Canadian railway matters generally. The terms of reference were rather lengthy and very wide, but it may suffice for our present purpose if we say that the preamble related that "it became necessary at the recent session of Parliament to make provision for assistance by loan to the Grand Trunk Pacific Railway Company and to the Canadian Northern Railway Company in order that such companies might be enabled to meet obligations and to provide for payment of interest on outstanding securities." It should be added that owing to ill-health Sir George Paish did not serve and Sir William Acworth took his place and that Mr. A. H. Smith, possibly because he was a practical railwayman and, may be, in order to secure absolute impartiality, was the Chairman. The report—which, as has often happened in such documents, bears no date—appeared in the early summer of 1917 and was summarised in THE ENGINEER of July 27th of that year. The two main railway systems of Canada at that time were the Canadian Pacific and the Grand Trunk; the former was in a very prosperous financial position, but the latter, whilst it had always met its obligations, gave a very poor return to the stockholders. Additionally, there were the Grand Trunk Pacific, for which the Grand Trunk stood sponsor, and the Canadian Northern; the latter, although it only began operations in 1906, brought in many small, constructed and proposed, lines and, at the time of the report, possessed 5000 miles of railway, towards which, however, there had been grants and loans by State and local authorities to the amount of 300 million dollars. The Canadian Pacific was an actual transcontinental railway and it was the ambition of the Grand Trunk to reach out to the West and of the Canadian Northern to the East. As the report said, "public sentiment, which felt that the growth of the country justified and required more than one transcontinental line, undoubtedly sympathised with the companies' ambition." The natural solution was that the two companies should join forces, but negotiations towards that end failed and each set out independently to construct lines into the territory of the other. A very large measure of Government help was given to both, in the hope, possibly, that there would be not merely two, but three transcontinental systems. "An uninformed and unreasonably optimistic public opinion undoubtedly supported this action at the time," but the Royal Commission felt "that those responsible for the policy of the Grand Trunk and the Canadian Northern companies should have been wiser than the public."

The Chairman of the 1916 Commission made a minority report, in which he recommended that the Canadian Pacific be let alone; that the Grand Trunk operate its eastern lines and the eastern lines of the Canadian Northern; and that the Canadian Northern take its own western lines and those of the Grand Trunk Pacific. The majority report, however, advised that the Canadian Pacific should not be interfered with and that the Grand Trunk, Grand Trunk Pacific, Canadian Northern, and three other smaller lines should be taken over by the Government and become the Canadian National Railways. That, in due time, was done, and it will be remembered that, in 1922, Sir Henry Thornton, the general manager of our Great Eastern Railway, became the president of the Canadian system. With such an energetic personality at its head, backed by money liberally voted by Parliament for the extension and development of its own railways, great progress was made, and what had been a reproach became a matter for praise. The success was, however, short-lived. The Canadian National Railways had successive deficits and the Canadian Pacific had to halve its dividend on the common stock. Consequently the present Royal Commission was appointed in November last. It consists of seven members, with Mr. Justice Duff as the Chairman and Lord Ashfield, o 'the London Underground, and Mr. L. F. Loree, of the Delaware and Hudson, as practical railway administrators. The report will be presented to the Canadian Parliament on October 6th. Meanwhile, a summary thereof has been made public. It assigns the trouble to various causes over and above the reactions of world-wide trade depression and the competition of road transport. Of what we consider of prime importance among the other reasons given as to the affairs of the Canadian National Railways are:—Special disabilities owing to the assumption, through the Government's action, of insolvent railway systems for reasons of national credit; large capital expenditure for the improvement of the physical condition of the systems thus absorbed; and political and community pressure on the management arising from direct governmental control. There are, of course, other reasons, and they apply equally to the company-owned Canadian Pacific. They, to our mind, being more easily remedied, are of less importance. They are:—The overdevelopment of the railways beyond the immediate needs of the country; aggressive and uncontrolled competition between the two transcontinental systems; inelasticity of freight rates; and contractural arrangements with labour organisations which have established rigid wage scales and inflexible labour practices generally. The Commission rejects two possible solutions:—(1) The complete amalgamation, under public or private ownership, of the two concerns, and (2) the leasing, either in perpetuity or for a period, of the National Railways to the Canadian Pacific. Both proposals are rejected on the ground that they would establish a monopoly of such magnitude and importance as would place, in the hands of those responsible for the administration, powers which, if not properly exercised, would prejudice the interests of the Dominion as a whole. It is therefore recommended that the two systems should remain independent of each other, but that the management of the Canadian National should be emancipated from political interference and community pressure. The two systems should then co-operate so as to eliminate duplicate services and the avoidance of extravagance, and the burdens of the Canadian National should be reduced to reasonable dimensions by economies and the cessation of extravagant operation.

Naturally one asks whether this is an object-lesson for British railways. At first sight it might appear that that question could be answered in the negative. There is no parallel here of competition between State-owned and company-owned railways, and we may recall that when Gladstone, in 1844, secured the terms under which, when Parliament decided to do so, certain, but not necessarily all, British railways should be purchased by the State, it was laid down that public resources should not be employed to sustain an undue competition against any independent company or companies. The wisdom of that provision is made manifest by what has occurred in Canada. There the extravagances of a system which had national finances behind it obliged a rival not blessed with equal resources to incur greater expenses than it could bear, and eventually landed both concerns in the difficulties from which the present Royal Commission is endeavouring to save them. Had the National been in the same financial position as the C.P.R., it is unlikely that competition would have been carried to a point at which it threatened to ruin both companies; it is more probable that the wise agreements which have distinguished British railway systems in recent years would have supervened and provided services that were both economical and efficient. The Report shows clearly the evils of Government ownership; the disadvantages of "contractural arrangements with labour organisations which have established rigid wage scales"; and the objections to "inelasticity of freight rates." From the latter two evils British railways are to-day suffering acutely, and the report of the Royal Commission may, it is hoped, be of service to our own sorely tried undertakings.

Surfaces and Films.

EVERYONE who reads the latter part of Dr. Gough's lecture on "Corrosion-fatigue"—see our issue of September 16th—will find himself pondering upon the part that films and surfaces play in engineering and metallurgical philosophy. Indeed, if we may permit ourselves a paradox, we might say that the more we look into things the more we see the importance of their surfaces. But the surface is not always what it appears to be. It is sometimes covered by an integument of immeasurable thinness which is veritable armour against some species of attack; sometimes, on the contrary, one which is harmful instead of helpful. This skin, in the former case, is formed, as Bengough showed years ago in his researches on corrosion, by corrosion products, but it itself is proof against corrosion, and as long as it is intact defends materials against corrosive agents. Fortunately, the air itself will produce this film on metals, but, unfortunately, the pulling and pushing, the extending and compressing which it suffers when material is subjected to varying forces seems to make it permeable. Then the attacker gets through the joints of the armour, and the phenomenon, not very happily known as corrosion-fatigue, occurs. We hope we shall not be taken to task for this outline of an action which no one as yet completely understands. Indeed, the one thing quite certain about it is that a film is formed and that the local failure of that film leads to trouble. The opposite condition is presented when the strength of a metal is reduced by surface pits, fissures, and irregularities, which form centres of localised stress.

The case of the protective film in corrosion-fatigue and other corrosion problems is but one out of many in which we are beginning to recognise fully the importance of surface, and the part played by films. As an example of the former we may recall the recent discovery that the endurance of springs is greatly increased by the grinding of their surfaces; and of the latter those theories of lubrication which appear to turn upon what may be broadly described as film phenomena. For a long time it has been recognised that sharp angles set up areas of intense stress and induce failure under repeated loading; they act like vee notches which are known to accelerate fatigue failure. It is only a step from this large-scale notch to the very small one which may be made by a tool or an abrasive, or by surface cracking. It, too, although only surface deep, renders the part liable to failure. To what extent it does so (*a*) by the localisation of stress, and (*b*) by presenting favourable conditions for the initiation of corrosion-fatigue it would be unwise to say. "Stress concentration effects," said Dr. Gough, "enter largely into corrosion-fatigue phenomena, but

they are inadequate to account for the vastly increased velocity of corrosion under corrosion-fatigue conditions." Fortunately, we are not concerned here with the pursuit of a vexed problem, but solely with the fact that a mere surface effect, partly in the material itself, and partly, it would seem, in the protecting film, is responsible for the failure. An interesting corollary in this connection is the often observed fact that a highly polished steel surface rusts, under normal atmospheric conditions, much less rapidly than an unpolished one, and it will be recalled that in the early days of stainless cutlery the preservation of the polish was insisted upon. When we turn from surface phenomena of this order we find many examples of another kind. In problems of heat transmission it is probable that the efficiency secured by making fluids, gaseous or liquid, pass over transmitting surfaces at high velocity, is due to the tearing away of a film or layer of badly conducting vapours; whilst the value of a polished surface in preventing the exchange of radiant heat, an ancient discovery, is well exemplified in the silvering of the Dewar flask. It is, however, in lubrication problems that we come across the most recently recognised manifestations of film and surface effects. Here we have the phenomenon of chemical action at the surfaces between the lubricant and the metal lubricated, and, combined with it, the modern theories of film lubrication, which, following the views presented by Sir William Hardy, demand the consideration of films of only atomic thickness. In this connection we may recall as a matter of interest the claim of certain American investigators—as related in our issue of June 24th, 1932—that a succession of films or layers can be separated from a lubricated metallic surface, like the skins from an onion, and we may recall, also, the ingenious process by which a continuously new metallic film of extreme thinness is deposited from a lubricant containing zinc oxide upon the rubbing surfaces of a steel bearing.

It would be possible to extend considerably these few references to the importance of film and surface effects. Many of them have been familiar to scientists for a long time, but it is only in recent years that others have entered the engineer's field, or, at any rate, since their scientific importance came to be recognised and an effort made to understand them. It is probable that a great deal yet remains to be learnt about their influence. When Dr. Gough italicises a statement that "should the nature of the metal with respect to its environment be such that a flexible, adherent, and continuous protective film is normally formed, then the degree of protection afforded under corrosion-fatigue would appear to depend on the effect of the cyclic strains imposed on the film on its permeability and freedom from rupture," and when he goes on to say, also in italics, "the author considers that it is very doubtful whether stress, as such, is an important factor in corrosion-fatigue," it is clear that in this very important connection—for all parts subject to variation of stress must be liable to corrosion-fatigue—we must not look only below the surface, but with at least equal intensity at the surface itself.

The Institution of Mechanical Engineers in America.

No. I.

THIS account of the visit of the Institution of Mechanical Engineers to Canada and the United States must of necessity be a personal one. The story might have been written by another hand, the hand of one who, guided and informed by previous acquaintanceship with the two countries, could have recorded the progress of their social and industrial development and the manner in which it is being affected by the prevailing world conditions. As it is, our report is the work of one who, until August 26th, 1932, had never before set foot in the New World, who went forth on the trip as on a voyage of discovery to a land of which he had heard and read much, but with which he had still to make intimate personal acquaintance. In the course of his all too brief visit to the New World the writer may have failed to note facts and features which he ought to have noted and have been impressed by others which a more seasoned traveller would have ignored. For all these and other shortcomings he would plead that the crowded events of the trip left little time for deep reflection while it lasted, and that now it is over the process of sorting out its incidents into their proper order of relative importance is a lengthy and difficult one from which even yet he has not completely emerged.

The party, numbering about eighty men and thirty-five ladies, left Waterloo Station at 9.20 a.m. on Friday, August 19th. Before it there lay a trip which was to extend to a full thirty-one days, seventeen of which were to be devoted to travel by water and fourteen to travelling and sojourn on land. By sea and river over 6100 miles were to be traversed; by rail, more than 860 miles, and by motor coach or car, upwards of 500 miles. Altogether, the itinerary required an average of about 240 miles to be covered every twenty-four hours.

Southampton was reached soon after 11 a.m., and promptly at 1 o'clock the "Montrose," a Canadian Pacific liner of 16,400 gross registered tonnage, cast off. It was a warm summer's day with a calm sea and more than a promise of fog. Cherbourg was reached soon after 6 p.m., and some additional passengers having come on board by tender, the ship's head was pointed westwards and the voyage to the New World fairly begun. A patch of fog and the ship's syren blowing at minute intervals partially disturbed sleep during the first night out, but for the next four days even the worst sailor in the party could find little to complain about in the weather. The morning of Wednesday, August 24th, was bright and calm, but the temperature was noticeably lower than it had been. Experienced sailors said that they could "smell ice," and in the course of the forenoon it became generally known that news of the presence of icebergs ahead had been officially received by wireless from the Ice Patrol. In the afternoon two bergs were sighted, one on each side of the ship. Although the nearest was at least three miles away, many feet of photographic film were exposed upon it. At about half-past six on the evening of the same day, land, the coast of Labrador, was dimly discerned emerging from the clouds on the horizon, and at about 8 p.m. the ship reached the entrance to the Straits of Belle Isle, at the northern end of Newfoundland. Next morning we were again apparently on the high seas, although, in actual fact, we were well inside the Gulf of St. Lawrence. Not only was there no land in sight, but a gale—officially a "moderate gale"—was blowing, and not a few of the passengers began to recall with affection the comparative calm of the Atlantic.

For a time speculation prevailed whether Captain Dott would take the southerly route past the Island of Anticosti, or choose the somewhat quicker course to the north. An interesting technical point was involved. To the north of Anticosti the magnetic deviation is considerable, and for some apparently unknown reason is liable to erratic and quick changes of as much as a dozen degrees. Vessels fitted only with magnetic compasses generally shun the northern route, although it cuts off about 20 miles. The "Montrose" was fitted with Brown gyroscopic compasses, and was, therefore, indifferent to any changes in the magnetic deviation. Eventually, however, the onset of misty weather settled the point, and we took the freer, if longer, course to the south of the island.

It was at this time, perhaps, that some of the visitors received their first direct impression of Canada's magnitude. Several hours were occupied in sailing past Anticosti. Yet it is merely an island in the Gulf of St. Lawrence, the name of which is forgotten by most people after they leave school. Its area is, however, equal to that of Devon and Cornwall combined. Its population is barely five hundred.

Soon after breakfast on Friday, August 26th, the ship reached Father Point, near Rimouski, on the right bank of the St. Lawrence River. Here Canadian and United States Immigration Officers came on board to examine our papers and to assure themselves that among our number we did not harbour any criminals, lunatics, bigamists, or anarchists. While the Canadian formalities were quickly over, those to which we had to submit at the hands of the United States officer were, although enforced courteously, tryingly slow. At Father Point there also came on board Mr. W. G. Wright, representing the Canadian Pacific Railway. Mr. Wright remained with the party until the hour of sailing from New York and took over all responsibility for our tickets, baggage and hotel accommodation. Too much credit could hardly be paid to him for the quiet, efficient manner in which he executed his duties. Early or late he was a constant friend to every member of the party.

Quebec was reached at about 6 p.m. on the same day—the 26th—some twelve hours ahead of the scheduled time. Here we were joined by Mr. H. H. Vaughan and Mr. R. J. Durley, the chairman and honorary secretary respectively of the Montreal Reception Committee. The evening being fine, most of the party went ashore to explore unofficially some of the sights of the historic city. With others we lingered on the terrace in front of the Chateau Frontenac. We found ourselves, now that we were on the scene of the event, wondering more than ever at the daring with which Wolfe assembled his forces on the Isle of Orleans below us in the river, on that dark night in 1759 and slipped noiselessly upstream to the cove above the town, whence he and his men, scaling the steep cliff, reached the Heights of Abraham and took Montcalm by surprise. Both fell, the one in the hour of his triumph, the other in the hour of his defeat. The memory of that immortal contest is not forgotten in the city which was its immediate prize. The Highlander in Canada may still "in dreams behold the Hebrides," but of the inhabitants of Quebec it may even to-day be said concerning nearly them all that "the blood is strong, the heart is *French*."

With the light—and the rain—of morning, Quebec, we found, had shed much of the glamour which had seemed to surround it the previous evening. During the course of a hurried tour of the city early on the morning of the 27th, we found that Wolfe's Cove has been utilised for the construction of a dock, and that the Plains of Abraham have been laid out as a public park. Even the Citadel, which we were privileged to visit by courtesy of the Officer Commanding the French-Canadian Regiment in garrison, lost something of its allure. High above the river it had frowned forbiddingly down on us while we were still at a distance, but once inside its ramparts we found it to be little more than a barracks erected long after Wolfe's time, and armed with muzzle-loading cast iron guns.

By 10.30 a.m. we were back on board the "Montrose," and leaving Quebec for Montreal, 139 miles further up the St. Lawrence. Six miles out the ship passed beneath the Quebec Bridge, that monument to man's persistence in the face of disaster. The nearer we approached the bridge the more certain did it seem, by some strange illusion, that the ship's masts would strike it. Not unwisely, perhaps, the Canadian Pacific Company reassures timid passengers that its vessels clear the bridge by 15ft. to 20ft. A drizzling rain did much to spoil the enjoyment of the morning. In the afternoon the sun shone warmly for a time. Later, a curious horseshoe-shaped cloud was observed sweeping rapidly over the land towards the river, accompanied by peals of thunder of increasing intensity. Suddenly the storm reached us, and for well over half an hour the ship laboured through a blinding sheet of rain, accompanied by vivid lightning and a shrieking wind. Visibility was reduced almost to vanishing point, the ship's syren was turned on as in a fog, and only by going outside the marked channel did a down-coming steamer pass us in safety on the lee side. The rain and wind ceased as suddenly as they began. When the storm was over, our captain would not admit that it had been anything more than "a severe rain squall." The St. Lawrence, with characteristic fickleness, undoubtedly treated us badly so far as the weather was concerned. We saw it in most of its moods, from the gale with which it received us to the vivid "electrical storm" which played round Montreal as that city was approached towards 11 p.m. on the 27th.

Following an early breakfast on Sunday, August 28th, the party left the "Montrose" for good. It had been a very happy, interesting, and on the whole comfortable voyage. The Engineers and their ladies constituted about 25 per cent. of the total number of cabin and tourist passengers on board, and naturally from the outset formed a friendly group. It is true that in organised parties, by courtesy of the chief engineer, Mr. Galloway, we visited the engine-room and inspected the gyro-compass equipment, that the ladies similarly inspected the ship's kitchens, that some of us took lessons in navigation on the bridge, and that at least one member pursued his thirst for technical experience to the extent of ascending the interior of the forward mast until he emerged at the crow's nest. Taken broadly, however, the voyage was regarded by most of the party as a holiday period, which was not to be invaded by thoughts or talk of "shop." The usual games, shuffleboard, deck tennis, horse racing, and so forth, occupied the daylight hours, and when night fell we had dancing, a ship's concert, a cinematograph exhibition, and an address on the coming total solar eclipse by the Rev. T. E. R. Phillips, the secretary of the Royal Astronomical Society.

On landing at Montreal on Sunday morning, August 28th, we were treated courteously and expeditiously by the Canadian Customs authorities, and were at once driven to the Windsor Hotel. Montreal, "the second largest French city in the world," is situated on an island at the junction of the Ottawa River with the St. Lawrence. Just above the docks are the Lachine Rapids, which bar the river to further ascent by ocean-going vessels. As elsewhere on the St. Lawrence, the obstruction has been short-circuited by means of a canal. For the present, these various canals are not of uniform capacity, but under the St. Lawrence Waterway Agreement, an outline of which was given in our issue of August 12th, works of improvement will, where required, be undertaken to provide a ship channel, 27ft. deep and 600ft. wide throughout, by means of which ocean steamers will be enabled to ascend past Montreal and penetrate right to the head of the Great Lakes.

On Sunday, August 28th, after a very short rest at the Windsor Hotel, one section of the party set off to visit the new Beauharnois Canal works. This scheme is a very ambitious one. The canal as at present planned is 15 miles long and 3300ft. wide. It serves to cut off four rapids which lie in the St. Lawrence next above the Lachine Rapids. In addition, it is planned to develop initially half a million horse-power at the site. Eventually, if the necessary powers can be secured, the whole of the St. Lawrence may be diverted through the canal, thereby, it is stated, restoring the river to its prehistoric course. If this development is carried out something like two million horse-power will become available for exploitation. An illustrated description of the Beau-

harnois Canal works appeared in our issues of February 13th and 20th, 1931.

The second, and larger, section of the party greatly enjoyed an interesting drive by motor coach along the southern shore of the island of Montreal to Macdonald College, 25 miles out from the city. This college, delightfully situated in open country at the island-studded end of Lake St. Louis, constitutes the agricultural and domestic science department of McGill University. Lucky, indeed, are the young farmers and budding housewives whose lot it is to be trained at Macdonald College. The visitors were greatly impressed with this, their first insight into Canadian educational facilities, and with the excellence of the college-grown products which were laid before them on the luncheon table. Returning to the city by a different route, the party had an opportunity of studying Canadian country and suburban life. Here and elsewhere it was noticeable that, outside the towns, square wooden houses with a verandah, on which invariably there was a rocking chair, constituted the dominant style of architecture. In the cities both of Canada and the United States the solidly constructed stone buildings and the broad well-laid streets give an impression of established age, although it was noted that anything over a hundred years old was spoken of as "historic." Only a short run, however, was sufficient to take one into districts about which the atmosphere of the early settler and his log cabin still seemed to linger pleasantly.

In the evening of the same day an informal reception was held at the Windsor Hotel to meet the members of the Montreal Branch of the Engineering Institute of Canada, that large organisation which embraces within its compass civil, mechanical, electrical, and all other species of engineers without distinction. To the Institute and its Secretary, Mr. Durley, the members of the party individually and as a body are indebted to a very large extent for the success and enjoyment of their sojourn on Canadian territory. At the different towns which were visited the local branches of the Institute seemed bent on rivalling each other in the warmth of their welcome and the degree of their hospitality. Equally handsomely were we received in the United States by the members of the American Society of Mechanical Engineers. However late at night we might arrive, however early our start might be in the morning, there were always present some members of the local reception committees to greet us or to speed us on our travels. In many cases they would come long journeys to meet us and would remain with us until we left their territory. To the members of the various ladies' reception committees a special word of acknowledgment is due for the unbounded hospitality which they extended to the ladies of our party and for the individuality of the manner in which they received them.

The morning of Monday, August 29th, was devoted to a number of alternative visits to works and places of interest in or near Montreal. Many of the visitors spent part of the forenoon at the Angus Locomotive and Car Shops of the Canadian Pacific Railway and later proceeded to inspect the establishment of Canadian Copper Refiners. The Angus shops were built in 1904 and constitute the railway company's main establishment for the manufacture and maintenance of locomotives, passenger cars, freight cars, and other equipment. They now occupy a ground space nearly ten million square feet in area and normally provide employment for between 6000 and 7000 men. On the locomotive side the works are almost wholly devoted to repair and maintenance, for with the exception of new and special designs it is the policy of the company to place its orders for its engines with private locomotive builders. The visitors evinced particular interest in the cast iron wheel foundry, in which the wheels for freight cars are made. These wheels are cast complete with their tires in chill moulds and are simply bored and faced at the boss before being assembled on their axles. No other machining is performed on them subsequently, even the tire surface going into service as cast. At the time of our visit all the shops were completely idle, for under prevailing conditions an occasional week's work is sufficient to overtake the repairs coming forward. As a whole the shops, neither in their arrangement nor in their equipment, seemed to us to surpass, even if they equalled, similar establishments in this country.

The Canadian Copper Refiners' works is a new undertaking, which receives copper from the smelters and purifies it electrolytically. The crude copper is cast into anode plates, which are placed in baths of heated electrolyte, the cathodes of which are thin sheets of pure copper. In from thirty-two to forty-five days the cathodes are built up to about 200 lb. each while the anodes have wasted away to very thin sheets. The pure metal of the cathodes is melted and cast into bars ready for drawing into wire in an adjoining works. The remains of the anodes are melted and recast and the slime from the electrolytic tanks is treated for the recovery of gold, silver, selenium, and tellurium. While we were at these works the fire bell rang and the shop team turned out with hose pipes to deal with an outbreak on the roof of one of the departments. It was, however, a false alarm. Actually it was a test call put through by the insurance company to make sure that the team was being maintained and to measure the time taken by it to get together and reach the imaginary scene of the outbreak.

Other works visited by different members of the party on this day were those of the Dominion Bridge Company, the Northern Electric Company, the Montreal Island Power Company, and the Montreal Harbour Works.

In the afternoon there was a reception at McGill University by Sir Arthur Currie and other members of the staff. In addition to the usual equipment the engineering section of the University contains a very complete department devoted to the practical and theoretical study of papermaking. This department represents an excellent example of co-operation in a ilberal spirit between a university and a particular industry.

On the evening of Monday, August 29th, the party left Montreal by a special Canadian Pacific train for Ottawa, which was reached after a run of about two hours.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

"OVER 100 PER CENT. EFFICIENCY."

SIR,—In reply to the letter by "M.I. Mech. E." in your last issue, may I say, first of all that I still completely uphold my two previous letters, and secondly, may I give the following simple explanation as to why the cycle proposed by "M.I. Mech. E." is inherently considerably less efficient than the basic Brown-Boveri explosion cycle?

Fig. 1 shows the apparatus required to carry out the cycle proposed by "M.I. Mech. E." The cycle is essentially as follows:—Air compressed by the compressor, say, to 2 atmospheres absolute pressure, is delivered to the combustion chamber and boiler at this pressure, valves A and C being open so that the incoming air drives out the products of combustion left in the combustion chamber and boiler from the previous cycle. When the combustion chamber and boiler are full of air, valves A and C are shut and valve B is opened, admitting the requisite amount of

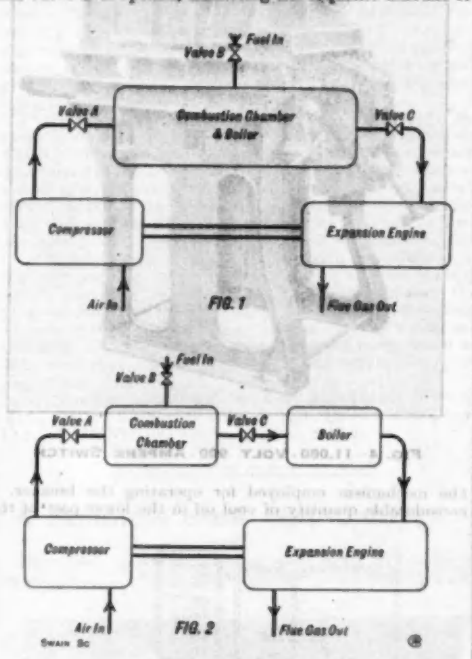


FIG. 1

FIG. 2

fuel. The combustible mixture in the combustion chamber and boiler is then ignited, the pressure rising rapidly to a maximum. Then it is assumed that the whole of the products of combustion are cooled down to a uniform temperature and pressure before valve C is opened. Now, if it be assumed that at the same temperature and pressure the products of combustion will have the same volume as the air before combustion, and if the effect of the presence of water vapour be neglected, then it is quite true that for a boiler efficiency of 100 per cent. and for the expansion engine unaided to drive the compressor, then both the expansion engine and the compressor must have an efficiency of 100 per cent. Thus with regard to the theoretical possibilities of his own cycle I am in agreement with "M.I. Mech. E.," but as the next paragraph will show, a very different state of affairs obtains in the case of the Brown-Boveri explosion cycle.

Fig. 2 shows the apparatus required for the basic Brown-Boveri explosion cycle. It will be seen that the only difference from the preceding cycle is that the combustion chamber and the boiler are separate, and that valve C is placed between the combustion chamber and the boiler. The first part of this cycle is as in the preceding cycle; but in this cycle, after combustion has taken place and the pressure in the combustion chamber has risen to a maximum, then valve C is opened so that hot gas passes from the combustion chamber to the boiler, and so that cold gas may pass from the boiler to the expansion engine at a considerably higher pressure than the pressure at delivery of the compressor. Naturally, as the pressure in the combustion chamber drops, so will there eventually be a decrease in the pressure at inlet to the expansion engine; but the important point is that a very much higher mean pressure may be maintained at inlet to the expansion engine than would be possible in the case of the preceding cycle. Now, if the expansion engine is so designed as to use the higher mean pressure drop, it is by no means inconceivable that, although the temperature at exhaust from the expansion engine is lower than that at inlet to the compressor, the expansion engine unaided might still be able to drive the compressor owing to the considerably greater mean pressure difference across the expansion engine. Thus we should have a boiler efficiency, including necessary auxiliaries, which would be very slightly greater than 100 per cent.

Perhaps this letter might with advantage be read in conjunction with my first letter. A. H. WARING.

Norton-on-Tees, September 25th.

CHEAP GAS.

SIR,—The proposed reduction in the cost of manufactured gas from 3s. per 1000 cubic feet to 10d. by the Rotherham Gas Company is so far-reaching in its possible consequences that it is hoped confirmation of this scheme will be forthcoming and that it may only be the forerunner of a general reduction.

At 10d. per 1000 gas competes with crude oil if it has the thermal value associated with ordinary towns' supply, and since it offers for 10d. heating value obtainable only for some 7s. 6d. if bought from a coal cart, its appeal to the domestic consumer must be enormous; besides this it revives the simple gas engine and may even prove a rival to petrol for some classes of road service if carried in compressed form.

It was an old dictum that the pithead was the correct location for the gasworks, and the recent developments in "farming" coke oven gas from the collieries goes to prove this correct. I do not know if it is to that development we owe this promised boon, but the importance of the reduction would appear to merit wider publicity than that accorded it in your short paragraph on page 316 in your current issue, when confirmation is possible. S. P. C.

Seaford, September 25th.

SIXTY YEARS AGO.

WE have already referred to the contents of the issue of THE ENGINEER for September 27th, but, barely exceeding the sixty-year range, we return for one moment to the same number, for we believe that "A List of Velocities" which is given in it may be found useful to historians. The list was taken from a German source and is presented in metres per second. It opens with the average velocity of the burning of Bickford fuse, and ends with that of the discharge of a Leyden jar. Some of the figures are of particular interest to engineers, as, for example, 0·11 m. per second for turning, boring and planing wrought iron; 1·0 m. per second for the velocity of water in reciprocating pumps; 4·00 m.p.s. for river steamers in still water; 5·00 m.p.s. for the average velocity of marine steamers; and 20·0 m.p.s. the highest permissible velocity of German passenger trains. From internal evidence one would say that the compiler was principally interested in textile factories. . . . In our issue of October 4th, 1872, we find an account of a primitive and crude fatigue test of wrought iron which was made in France. It tells us that "the apparatus consisted of a bent axle, which was firmly fixed up to the elbow in timber, and which was subjected to torsion or twist by means of a cog wheel connected at the end of the horizontal part." At each turn the angle of torsion was 24 deg., and a shock was produced each time that the bar left one-tenth (? tooth) to be raised by the next." The axles, for several were used, appear to have been about 2¼in. in diameter. In one case, after the specimen had sustained 120 torsions and subsequently been broken in an hydraulic press, the fibres appeared under the microscope to be "without adhesion, like a bundle of needles." In another specimen, broken after 338,000 torsions, an increased size in the grain of the iron was visible to the naked eye. In a sixth test, which continued for ten months, the axle underwent 78,732,000 torsions and shocks, but had to be broken hydraulically. The fracture exhibited "an absolute transformation, the surface of the rupture being scaly like pewter." For the seventh and final test the axle was subjected to 129,304,900 torsions and the ruptured surface was similar to that of the sixth. It is added that "the crystals were found to be perfectly well defined, the iron having lost every appearance of wrought iron." Whilst these experiments are interesting, we ought perhaps to remind our readers that fatigue tests were made many years before by Hodgkinson and that Fairbairn's celebrated tests of a built-up girder under repeated stresses were carried out for the Board of Trade in 1860–61. It was not till nearly ten years later, 1870, that Wöhler entered the field with his celebrated experiments and now familiar method of testing. We need not add that the modern science of metallurgy has disproved the crystallisation theory of fatigue.

BOOKS RECEIVED.

Third and Final Report of the Adhesives Research Committee. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2. Price 2s. 6d. net.

Ten Years of Industrial Psychology. By H. J. Welch and C. S. Myers. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C.2. Price 6s. net.

The "III. F" (G.P.) Aeroplane (Two-seater General Purpose Type "Lion XI. A" Engine. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2. Price 2s. 6d. net.

BROOKHIRST OIL PRESSURE CIRCUIT BREAKER

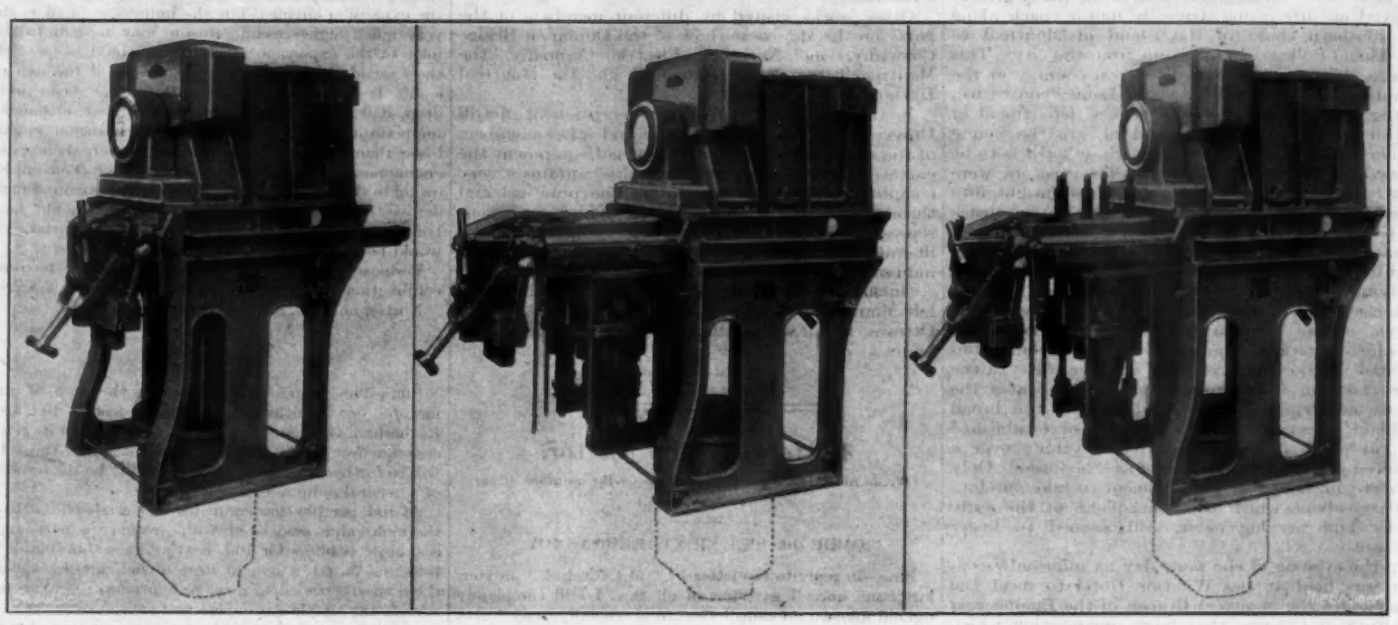


FIG. 1—TANK LOWERED

FIG. 2—BREAKER WITHDRAWN

FIG. 3—ISOLATOR CARRIAGE RAISED

Oil Pressure Circuit Breakers.

THE attention which is being paid to improved methods of circuit breaking to meet the requirements of present-day electrical practice is a clear indication that the standard designs of high-capacity switchgear are not universally regarded as satisfactory. The various proposals which have been put forward in connection with the switching problem, and which to some extent have been adopted abroad, are too well known to call for description; but a new design of heavy duty A.C. breaker recently introduced by Brookhirst Switchgear, Ltd., of Chester, can scarcely fail to interest engineers who are anxious to consider the merits of British switchgear developments. Manufactured under licence from Whitehead's Electrical Inventions, Ltd., of Cardiff, the design is claimed to result in increased mechanical strength, reduced bulk, simple construction, and accessibility. Briefly stated, the new breaker has a high rupturing capacity whilst occupying a relatively small amount of space.

The makers explain that while the principle of quenching the arc by means of moving oil is regarded by competent authorities as ideal, owing to the lack of a reliable and economical method of creating and controlling the oil movement the production of commercial circuit breakers working on this principle has proved a difficult problem. In the design under consideration, however, the oil pump, which is operated by the switch and which is placed in the centre of the ring of contacts, as indicated in the drawing, Fig. 5, is quite a simple and inexpensive affair. It will be perceived that when the switch is opened and the pump piston is forced down by the spring behind it a bodily movement of the oil under high pressure is produced. The whole of the oil in the lower compartment of the switch tank is placed under controlled pressure, and when breaking the circuit the arcing chamber is entirely filled with a body of moving oil. Clearly, therefore, the scheme differs from the oil jet method of operation. As the oil pressure is definitely predetermined, it takes immediate control of the arc and gas bubble, which is not allowed to expand and control the movement of the oil. The cylindrical tank ensures maximum strength. The upper main contacts are designed to form a combined contact and explosion pot of special construction accommodated within arc-quenching and shrouding cylinders composed of reinforced insulation. When the pump is operated, by means of the mechanism employed for operating the breaker, a considerable quantity of cool oil in the lower part of the tank is forced at high pressure through the arc-quenching cylinders and through the upper explosion pot contact, thus restricting and controlling the shape and expansion of the gas bubble.

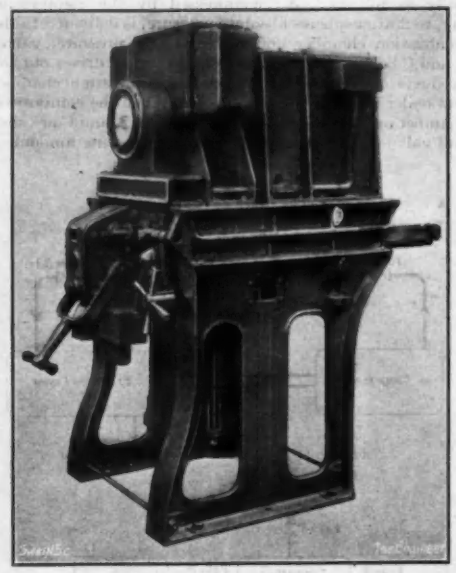


FIG. 4—11,000-VOLT 900-AMPERE SWITCH

As the contacts part the gas bubble and arc are attacked simultaneously and independently. Cool oil moves rapidly upwards through the special explosion pot upper contact and past the point of break, thus arresting and quenching the explosive vapours which would otherwise expand into the vortex which would be formed by the fall of the lower contact. The impetus of the rising oil effectively checks the downward expansion of the explosive vapours, whilst the body of cold oil moving upwards through the shrouding cylinders condenses the gases as they rise. Deprived of its conducting medium, the makers explain, the arc cannot re-strike, for the lower contact falls through a sparking ring which is surrounded by a moving column of cool oil under pressure. As regards length and speed of break, the contact bar follows established practice and moves independently of the pump, so that after the moving contact has broken the circuit the pump still maintains the pressure for a certain period, thus giving further assurance against restoration of the arc and efficiently scavenging the arcing chamber and upper contacts. Although a cylindrical tank is employed, the makers have not relied on the mechanical strength of the housing when considering rupturing capacity. The object aimed at has been to control the arc and gas bubble and not to base performance on the ability of the tank to withstand internal explosion. Nevertheless, mechanical strength, length, and speed of break and head of oil compare favourably with those of existing designs.

The lower portion of the specially designed explosion pot, which is combined with the main upper contact, is in the form of a machined surface which makes contact with the moving brush, but the actual arcing takes place on an arcing plug which fits inside the explosion pot contact. The travel of the arcing plug is timed so that the oil pressure and movement are secured before the arcing plug leaves the upper sparking contacts. Three large removable and self-aligning arcing fingers are accommodated in the walls of the upper main contact, and owing to the ample clearance between the main contacts before the final break occurs on the arcing plug, pitting and burning of the main contacts are avoided. The upper and lower main contacts are self-aligning and self-cleaning and are easily removed. As the contacts are completely shrouded in cylinders of reinforced insulating material, forming arc-quenching chambers, the usual phase barriers

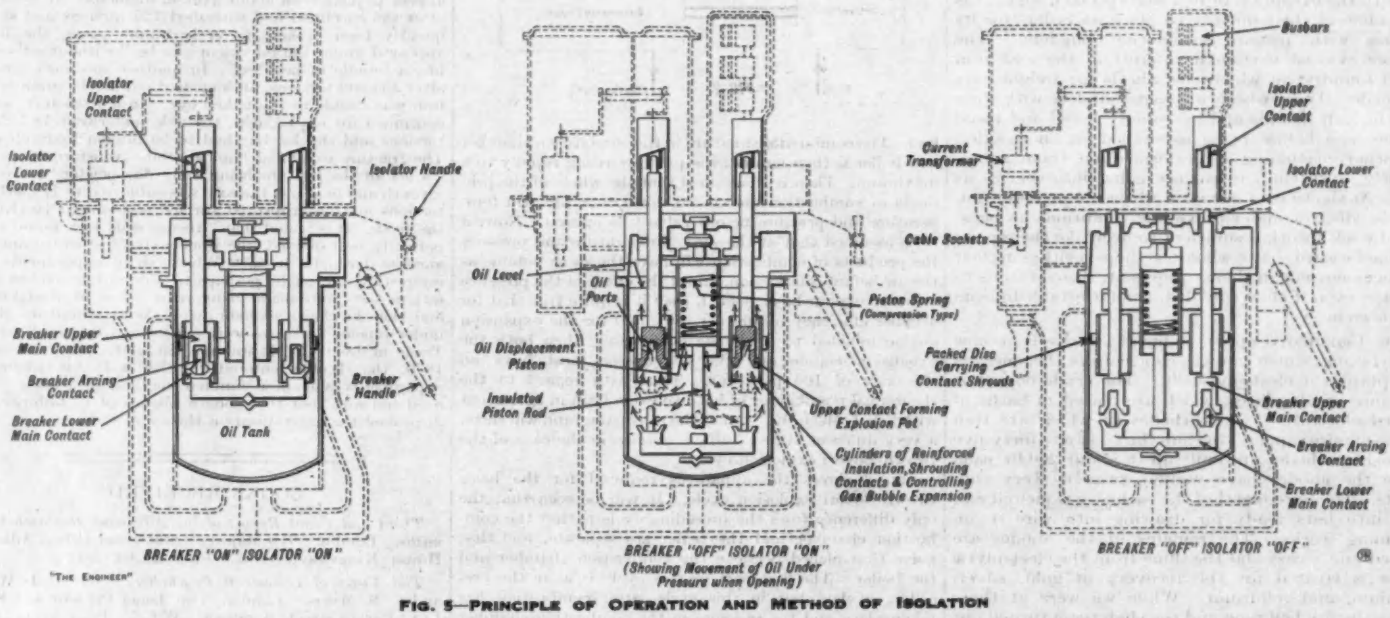


FIG. 5—PRINCIPLE OF OPERATION AND METHOD OF ISOLATION

and tank lining are unnecessary, but it will, of course, be understood that these barriers also play an important part in the way of controlling the expansion and movement of the arc and gas bubble.

The moving carriage to which the switch stems are clamped for isolating purposes is claimed to contribute considerably to the mechanical strength of the switch. Strong compression springs ensure a high contact pressure and double compression springs a high-speed break. As the pump piston is not actually coupled to the switch mechanism and the breaker opens independently of the piston, the pump does not introduce any dashpot or retarding effect nor any danger of welding of the contacts.

As will be gathered from Figs. 1, 2, 3, and 5, the Whitehead system of internal isolation permits the breaker and components to be readily isolated for inspection and test, and it has an important bearing upon the space factor. As compared with designs in which isolation is obtained in accordance with the drop-down or draw-out principle, the scheme under consideration gives a saving in headroom in one case and floor space in the other. Instead of having to move the actual breaker either downwards or forwards, it is only necessary to move the comparatively light isolator plate within the switch top plate. After isolation, which is carried out in the manner shown in Fig. 5, the tank can be lowered, thus making the interior of the switch visible and accessible without moving the switch. Although not necessary for the purpose of examination or isolation, the breaker can be drawn out for closer inspection, as shown in Fig. 2, or alternatively, the breaker and tank can be completely removed and taken away. As will be perceived from the illustration Fig. 4, the slide rails which permit the breaker to be withdrawn do not protrude in front of the switch whilst it is in normal service. Features which will appeal to all engineers are the ease with which the breaker can be racked out free of the oil tank by means of a simple ratchet operating handle at the back of the switch and the saving of space. Other parts of the switch, such as cable box, bus-bars, and current transformers for the operation of the trip coils, are also readily accessible.

Interlocks are, of course, provided to ensure safety. It is impossible to make or break the circuit on the isolator, which cannot be operated unless the breaker is "off." The oil tank cannot be lowered unless the isolator has been opened in the manner indicated in Fig. 5, nor can the isolator be closed before the tank has been raised or the breaker be racked out unless the isolator is "off." When the breaker is drawn out the stationary line contacts of the isolator are immediately covered by a simple disc shutter which operates on its own accord.

The illustration Fig. 4 shows a 900-ampère, 11,000-volt circuit breaker with all its parts in position; Fig. 1 the same breaker with its tank lowered; and Fig. 2 shows the breaker drawn forward. Fig. 3 is a similar view, but shows the isolator carriage raised. The oil pressure scheme described has also been embodied in low-tension breakers, together with internal isolation; but, owing to the smaller size of the movable portion of these units, the tank is drawn out with the breaker carriage, irrespective of whether it is in the raised or lowered position. Apart from the fact, however, that the contacts are of a somewhat more simple type, all other parts are similar to those on the E.H.T. switch and operate in the same way.

Automatic Carbon Arc Welding.

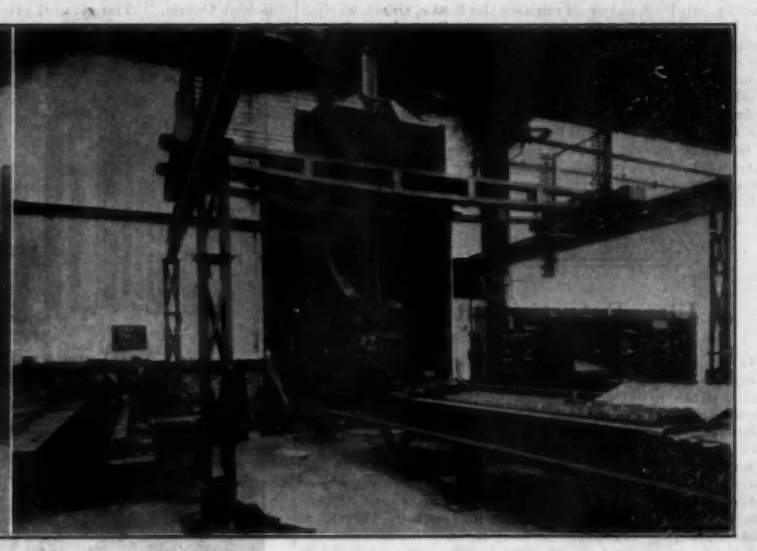
THE automatic carbon arc equipment illustrated in the accompanying engravings has been in operation for some time at the works of one of the largest boilermakers in this country, automatically welding plates, tanks, stiffeners, and other constructional details.

One engraving gives a view of the plant and an idea of its size. It shows the gantry, carrying the bridge, which supports the crab carrying the welding head. Incidentally, the gantry, bridge, and constructional details of the head and crab are entirely of welded design. Two welding motions are possible, for the crab carrying the welding head moves across the bridge whilst the bridge travels up and down the gantry.

It will be seen that no clamping of the stock to be welded is necessary, as this is merely tacked by hand and rested on or against the heavy H sections which act as a table. The same engraving also shows the small main switchboard on the right hand, which carries the recording instruments with relays controlling the arc, the main welding contactor, and auxiliary motor contactors.

Another engraving shows a U-shaped girder being welded to an angle iron. The operator has his left hand on the wheel of the crosshead of the welding head and is watching the weld through the protective glass window of the asbestos shield that surrounds the arc. His right hand is at liberty to work the push button controls on his right, which enable him to control the speed of welding, the direction of traverse, the striking of the arc, and the raising and lowering of the head, &c. All the operations are under his immediate control, so that the arc can easily be steered along irregularities of seams and careful adjustment of stock preparatory to welding is not necessary. The actual carbon head is hidden by the asbestos shield and the casing. Two large reels are fitted at one end of the welding head. They carry respectively filler wire of 2 mm. diameter that is fused in the arc, but carries no current, and twisted paper which is fed to rub on the white hot carbon and in combustion generate a gas surrounding and protecting the weld from contamination by oxidisation from the atmosphere.

WELDING ANGLE IRON TO GIRDER



GENERAL VIEW OF WELDING PLANT

The welding generator is direct coupled to the driving motor and has separate excitation, whilst the small motors which provide the various drives are both three-phase and direct current. A fan for exhausting the gases from the arc, a cooling water pump, mechanically interlocked to prevent operation if the water is not circulating, a drive for the filler wire and twisted paper, a motor to feed the carbon, electrically operated hoisting and lowering gear of the head with magnetic brake, and traversing arrangement of the crab and the bridge with gears and clutches having quick returns are all under the operator's control from the push button board on the welding head. Various welding speeds up to 120ft. per hour, suitable for seal welds, are available, the most suitable average speed being taken as 70ft. per hour where appearance and strength are of importance.

The machine illustrated will butt weld plates down to ¼in., and is supplied by the A.E.G. Electric Company, Ltd., of 131, Victoria-street, London, S.W.1.

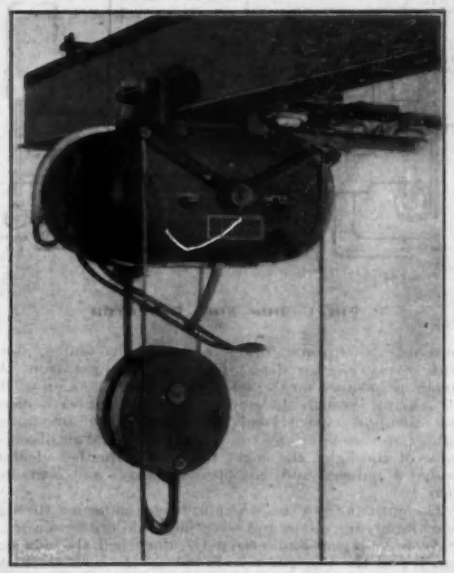
A Stainless Steel Belt Conveyor.

BELT conveyors with stainless steel bands, cold rolled in lengths of up to about 400ft. and less than 1 mm. in thickness are now made by the Sandvik Steel Works, in Sweden. As these bands in most cases are immune from rust, it is expected that they will find extended use in industrial establishments where strict cleanliness is necessary, such as foodstuff factories, and they have also a likely field in the chemical industry and generally in localities where the air contains steam or acid gases. The bands are cold rolled in widths of up to 800 mm., but can be longitudinally jointed by a special process into still greater widths. Such a jointed strip is shown in the accompanying engraving.

STAINLESS STEEL CONVEYOR BAND

Electric Pulley Blocks.

SOME useful electric pulley blocks, suitable for lifting and conveying goods from place to place in factories and other industrial establishments, have been brought to our notice by the T.B.T. Electric Company, Ltd., of 171, Queen Victoria-street, E.C.1. They are supplied for lifting loads from 2 cwt. to 1 ton and for various lifting speeds. In the case of the 1-ton double-purchase block shown in the accompanying illustration traversing is done by pushing the load, but blocks are also supplied which are traversed along the overhead girder by means of a chain. The totally enclosed crane type motor for lifting complies with the B.E.S.A. Specification No. 168/1926 and is fitted with ball bearings. When D.C. is used for operating the blocks the motors are series wound, while for A.C. operation a squirrel-cage machine is usually employed. The D.C. motors can be wound for any pressure between 110/480 volts and two or three-phase motors for any pressure between 200 and 500 volts, 50 cycles. If necessary, motors can be supplied for other periodicities and blocks with a lifting capacity up to 3 cwt. can be fitted with single-phase machines.



1-TON PULLEY BLOCK

As the load is lowered by gravity a switch is only required for lifting. A quick-break D.C. switch interrupts the current in two places, and in the case of A.C. two phases are each broken in two places. Like all the other electrical equipment, the motor is insulated to withstand dampness. The wheels of the spur gearing have teeth cut from the solid. In one type of block there are two sets of reducing gears and in another type three sets. The various hoisting speeds corresponding to specified loads are obtained by the suitable selection of change wheels which rotate on fixed studs and can easily be lubricated. The rope is wound on the plain cast iron winding drum in layers, the drum shaft being supported in grease-lubricated cast iron bearings. The block type sustaining brake with Ferodo-lined shoes acts on the motor pulley and the shoes are lifted by a cam on the operating shaft. When either of the starting handles is pulled the brake is released. The centrifugal brake which prevents excessive speed when lowering, and which is also fitted on the motor shaft, consists of two blocks rotating inside a ring cast on the

motor end shield. At low speeds the blocks are kept out of contact with the ring by means of a spring, but when the speed reaches the normal value the centrifugal force overcomes the force of the spring, and by moving outwards and making contact with the ring prevents further acceleration. The hook is composed of a drop forging.

By removing the cast iron covers which are fixed in position by means of four bolts all the internal parts become accessible. A blue handle is attached to the lifting pendant cord and a red handle to the lowering cord, but for convenience in operation matters have been arranged so that both motions may be controlled by the blue handle alone. A short movement of this handle will cause the block to lower, whilst an increased movement in the same direction will cause it to lift, and by operating a block in this manner one hand is left free to guide the load. A strong pull switches on the current and starts the motor for hoisting, while an easy pull releases the brake, thus lowering the hook. When released the controlling lever automatically returns to the zero position, thus switching off the current and applying the brake. Upon reaching the highest position the hook actuates a limit switch lever fitted beneath the block, thus cutting off the current, applying the brake, and forcing the controlling lever back into the zero position. When lowering the current is cut off from the motor, and the operation is governed by the centrifugal brake, which prevents the speed exceeding one and a-half times the hoisting speed. Standard trolleys with current collectors are made for various types of girders or can be supplied to meet specific requirements.

Fire Detection at Sea.

ON Friday of last week, September 23rd, a representative group of engineers, shipbuilders, and shipowners attended a demonstration of the Automatic Light Control Company's patented marine fire-detecting and extinguishing system, which, by the courtesy of Royal Mail Lines, Ltd., took place on board the cruising steamer "Arcadian," berthed in Southampton Water. As will be seen from the drawing reproduced in Fig. 1, the system comprises an air suction system from the holds under control, a motor-driven selector system for operating the air suction valves, a smoke-detecting chamber embodying a selenium bridge and light source, and an electrical indicator and audible warning device. On the actual demonstration instrument, illustrated in Fig. 2, a CO_2 cylinder supplying gas to the holds, controlled by an electro-magnetically operated release valve, was added. The general principle of operation is as follows :—

Air from each hold is drawn by a suction fan through one or more of the 1in. galvanised pipes, connected to the selector mechanism, and shown at the foot of Fig. 2. The selector mechanism, by means of the cam-operated valves shown, alternately by-passes the air from each hold in turn through the smoke detector chamber, which

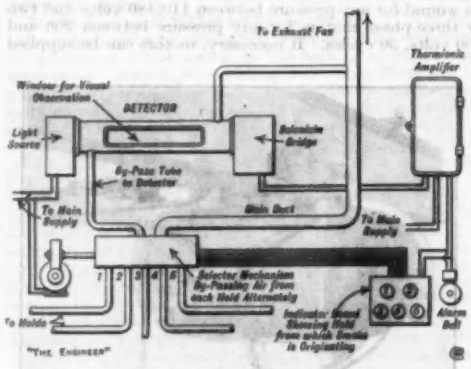


FIG. 1—SHIP FIRE DETECTOR

contains the selenium bridge and its light source, along with an interceptor disc. The beam of light from the source is focussed on the selenium bridge. So long as the air passing through the smoke detector chamber is clear, the selenium bridge receives its maximum amount of light, but as soon as any trace of smoke in the air obscures some of the light, the current output from the selenium bridge is reduced and this operates relays and contactor gear.

The current from the selenium bridge is passed through two amplifying valves and a rectifier, and operates a relay and contactor gear connected to the alarm bell, the indicator panel, and the CO_2 gas release valve. As soon as smoke issuing from any one of the holds appears in the smoke detector chamber, the CO_2 release valve is immediately opened, and the CO_2 gas passes into the same pipe line through which smoke is issuing. The alarm bell rings, and the lamp on the indicator panel corresponding to the particular hold from which the air is being by-passed through the smoke detector lights up, thus indicating the number of the hold in which the fire has been detected. As soon as this occurs, the motor driving the selector mechanism is stopped automatically and the bell rings continuously until the mechanism is reset by the hand control switch. Immediately the smoke is cleared from the detector chamber, the selector mechanism resumes its operation, the hold from which smoke was issuing and into which CO_2 gas is still passing being cut out, but all other holds kept under continuous observation.

On the "Arcadian" the forward hold was arranged as two holds, and smoke artificially produced was introduced to inverted funnels on the ends of the pipe lines leading to the selector mechanism. We noted that the alarm was given in less than 30 seconds after the smoke appeared in the hold, and the alarms sounded and warning lights were given at the mechanism and on the bridge. As the system has been designed chiefly for use in cargo ships, the case of dusty cargoes, such as coal or flour, has been carefully considered, and with such cargoes simple dust traps and filters are fitted in the pipe lines. This device prevents any dust from reaching the detection chamber and affecting the working of the apparatus. The test apparatus, which we inspected, is robustly constructed, and the selenium bridge, we were given to understand, is generally similar to that form of bridge used with sound reproduction apparatus, which has a long life even under practically continuous operation. The inventors claim that with the comparatively rare use of the apparatus in case of fire at sea, the life would be a very long one; but, on the other hand, the efficiency of the bridge would not be impaired by its comparatively infrequent use. The apparatus is so designed that it can be easily tested under operating conditions. The arrangements for the demonstration were in the hands of Engineering Marketing Services, of 110, Fenchurch-street, E.C.3, and after luncheon on board the Southampton tender "Solent Queen." The general principles of the apparatus

FIG. 2—FIRE DETECTOR

and its range of application were described by Mr. H. L. Read, of Automatic Light Control, Ltd., and Mr. A. C. Hardy and Mr. T. V. Tobin, of Engineering Marketing Services, who are to be congratulated on the excellent arrangements made for the demonstration and the success with which everything was carried through.

Plastic Metallic Packing.

A NEW type of plastic metallic packing, marketed under the trade name of "Sealite," has been brought to our attention by R. C. Taylor and Co., of 86, London-street, Greenwich, S.E.10. It differs from other metallic packings we have seen in its non-fibrous appearance and its constituent properties. It consists, we are informed, of 87 per cent. of a finely divided non-fibrous lead base alloy, to which has been added about 10 per cent. of graphite and a small amount of long-strand asbestos. The resulting mixture is smooth and soft to the touch. It can be broken up and moulded by the fingers and is easily packed into any shape of gland. When compressed, it gives, we understand, an impervious non-hardening uniform metallic sleeve, which, however, can be broken up and will combine easily with new packing. It is claimed to be self-lubricating under the most varied conditions and not to harden or perish under extreme pressure or temperature conditions. The packing is sold in cakes of standard weight packed for home or export. It has been successfully applied for water, steam, tar, and chemical packings, and two qualities are marketed: No. 2, more resilient, for use with scored or worn rods; and No. 3, specially designed for use with superheated steam, both qualities being suitable for use in hydraulic or steam glands.

The Belt System in an Indian Locomotive Works.

TECHNICAL Paper No. 281, published by the Government of India, gives a full description of the belt system of repairs introduced in the locomotive workshops at Kanchrapara of the East Bengal Railway by Mr. R. de Vere Irwin, Works Manager (Loco.), and Mr. J. R. Potter, Assistant Works Manager (Loco.).

The original works were built in 1863, as combined locomotive, carriage, and wagon shops. With the gradual extension of the system, and the consequent introduction of larger and heavier stock, it was realised that the combination was no longer capable of handling the work entailed, and in 1915 separate works were opened for the Carriage and Wagon Department, while the old shops, with some alterations, continued to deal with locomotive repairs only. However, with the evolution of the locomotive in recent years even these improvements became inadequate. Entirely new foundry, erecting, boiler, and tender shops were built, the rest of the works were remodelled and in 1929 the shops were completed as they stand to-day. The new erecting shop is 580ft. long and 70ft. wide, with actually very little more accommodation than the old one, but it was considered that this would be sufficient with the improved lay-out and employment of modern methods. To a certain extent this proved correct, but it was not until the belt system of repairs was brought into full operation in March, 1931, that it could really be said the Rs. 45 lacs spent on the remodelling had been justified. This may seem an extravagant statement, but when it is realised that the average number of days an engine spent in shops undergoing a thorough overhaul has been reduced from fifty-three to twenty-one days, and the number of engines in shops at any one time from thirty to ten, it will be realised that this is no exaggeration.

In the erecting shop there are two lines of pits and a centre running road, and pneumatic and high-pressure hydraulic lines run the length of the building. Electric points for portable drills, welding, lamps, &c., are spaced at convenient intervals. Two 60-ton cranes traverse the length of the erecting shop with sufficient clearance to enable them to lift one engine over another, and under these two 25-ton cranes operate over the total length of the erecting and boiler shops. Of the two lines of pits, one is used for engines undergoing heavy repairs on the belt system and the other for miscellaneous work, such as casualties, light repairs, erection of new engines, and heavy crane work, &c.

Under a lean-to, running the length of the shop, is a series of expanded metal godowns, each allotted to a stage on the belt, as explained later. The schedule is so arranged that all parts, viz., connecting and coupling rods, brake gear, &c. &c., are delivered to the correct depôts in advance of the arrival of the engines at that depôt. Racks and stands are provided alongside each pit on the belt for the storage of tools and materials of the men on that pit. These, with the godowns, provide ample accommodation for tools and spares and the littering of material about the floor of the shops is firmly discouraged. Since the introduction of the scheme the improvement in the general tidiness of the shops as a whole has become very noticeable. Except in the erecting shop proper, where the gang system of piecework pertains, the Rowan premium bonus system is in operation in varying degrees.

It is important to note that since the belt system was inaugurated no extra supervising staff has been engaged, the actual number of men employed in the shops has been reduced, overtime, which prior to the adoption of the system was considerable, has been stopped entirely and the shops are working only five days a week instead of six. In spite of these reductions in labour and time, the outturn of the works has only dropped by three engines as compared with the corresponding six months of last year, when a full labour force was employed over considerably longer hours. Moreover, it should be remembered that outturn to a certain extent has been restricted on the score of economy. Had this not been so, the outturn could actually have exceeded last year's figures.

Schedule boards are used throughout to indicate the progress of work. A master schedule board hangs centrally in the erecting shop. The dates of the month run horizontally at the top of the board, while the various operations to be carried out are given in a column on the left. The day before an engine arrives in shops, tickets bearing the engine number are prepared, one ticket for each operation. These are placed on the board below the date on which each job is due for completion. As soon as a job is completed its ticket is removed. Should there be any delay, the tickets are scored across in red.

The schedule is arranged to allow an engine fifteen working days in shops. This is reckoned from the time an engine enters the workshop gates to the time it passes out again. It should be understood that in this calculation all short period working, holidays, and Sundays are excluded.

THE ERECTING SHOP BELT.

The pit over which the belt is worked is divided into seven 43ft. sections or stages, which allow sufficient working room between two of even the largest engines. The stages are divided off by white cement insets in the flooring of the shop and by white lines painted on the crane girders above. These enable the lifting gang to place engines centrally on a section. Boards are also placed high up on the girders to indicate numbers of the sections.

Engines are due to arrive in shops at 6-30 hours. The tender is then cut and the engine moves under its own steam on to the central line of the erecting shop, where the motion, brake gear, and parts connected with the wheels are removed. It is then lifted on to the stripping and examination pit, at the south end of the shop, this pit being selected on account of its proximity to the bosh tanks. The time allowed for these several operations is four hours.

When complete stripping has taken place and the boiler has been taken to the boiler shop the frames are scraped and cleaned. They are then lifted to the first stage on the belt, on the opposite line of pits at the north end of the shop. Parts removed from the engine during stripping are placed in containers which are conveyed to the bosh tanks by a 5-ton travelling crane; after cleaning they are distributed to the various shops for attention.

The movement of the belt takes place every twelve hours. To avoid delay and the wasting of men's time the move on one day is made during the meal hour and on the next day at fifteen hours, *i.e.*, half-an-hour before the works close.

Prior to wheeling, units are lifted from one section to the next by the two 60-ton cranes, but, after wheeling, the remaining units on the belt are drawn forward by an electrical capstan placed immediately at the south end of the belt.

It happens, of course, that there are occasions when some of the operations on a particular engine are not completed to schedule time. Should the balance of work be not unduly large, a portion of the gang of that stage moves with the engine to the next, and the belt is not delayed. Should however, the delay be of an important nature, the engine is removed from the belt to a pit on the opposite side.

On leaving the seventh stage the locomotive is taken to the steaming shed to the south of the pits. It has then been in shops twelve working days and so, therefore, the

belt is designed and is capable of delivering one complete engine every one and a-half days.

THE TENDER SHOP BELT.

The tender shop is adjacent to and under the same roof as the erecting shop. Like the latter, it contains two lines of pits and a centre running road, and is also operated on the belt system.

When the tender is cut from the engine, on its arrival in the works, it is placed on the centre road of the tender shop. Here the wheels are taken out and the tender removed to the stripping pit, where the tank is lifted and placed on 6ft. trestles on the left-hand side of the shop. The frames, after stripping, are moved to the second stage of the belt. On this belt there are seven stages, including stripping, and the moves take place every twelve hours. As in the erecting shop, each gang is provided with its own godowns and other similar facilities. Here again the shop is fitted with pneumatic pipe lines and electric points. It is also equipped with two 25-ton cranes and is 300ft. long and 60ft. wide. The light plating shop is situated immediately to the north of it. As there are only seven moves in the tender shop against eight, including stripping, in the erecting shop, tenders are ready coaled and watered in advance of the engine.

Directly the works open in the morning the schedule chargeman makes his round of the boards and from them prepares a progress sheet. On this is given :—

(*a*) A list of jobs already on delay.
(*b*) A list of jobs due for completion that day.
(*c*) A list of jobs due for completion the following day.

Copies of these are handed to the works manager, his assistant, and each foreman before 9.30 hours.

At 13 hours each day the works manager holds a meeting in his office and this is attended by the assistant works manager, the erecting, fitting, machine and boiler shop foremen, and by the schedule chargeman. At this meeting the progress sheet is discussed in detail. All delays are inquired into, and, as far as possible, steps taken to remedy matters and prevent their recurrence. These meetings are not long. At the most three-quarters of an hour is expended on them, but they are of untold value. Large and small difficulties come to light. Each individual acquires a knowledge of the "snags" experienced by his fellows, and the whole tends towards a feeling of co-operation and mutual understanding throughout the works.

Aerial Mapping in Canada.

IT is, according to the Ministry of the Interior of Canada, just ten years since the new method of mapping by means of aerial photographs was started in that country, but the progress made has been most rapid. In 1922 the Topographical Survey, Department of the Interior, arranged with the Royal Canadian Air Force to take aerial photographs over a few experimental areas. A few rolls of oblique photographs were taken in Northern Manitoba, and a small area in Saskatchewan was photographed vertically. During that winter original plotting methods were worked out and the following year several areas were covered by oblique photography.

With the experience gained in that season's work an extensive programme was launched in 1924. From that year onward the work has steadily progressed. Each year has seen a deeper inroad made into the practically unmapped expanses of the northern territory of Canada, while at the same time accurate maps were produced of those special areas where important industrial or mining developments were taking place.

Up to the present time a total area of 402,500 square miles has been covered with aerial photography, comprising 125,000 square miles by vertical photographs and 277,500 square miles by oblique photographs. Vertical photographs are used for mapping on fairly large scales or where the country is rough or mountainous, while oblique photographs are specially well adapted for the exploratory mapping of those extensive areas of forest and lake of fairly uniform elevation which constitute such a large pro portion of Northern Canada. The photography has been done through a co-operative arrangement with the Royal Canadian Air Force. The Topographical Survey has been the central agency for the control of all the aerial photography required by the various Federal services. This control provides for the issue of technical instructions for the photographic operations, the indexing and filing of all photographic prints, and the plotting and compilation of maps from the photographs.

The methods used in plotting the mapping information from the photographs have for the most part been developed in Canada. In particular the oblique method is known as the Canadian method, and it has been adopted for use in other countries where conditions are similar. This method, because of its low cost, flexibility, and the small amount of ground surveys required, is very applicable to much of Canada, and by its use the geographical knowledge of Northern Canada has been extended in the last ten years in a way that would have been quite impossible by former ground methods.

During that period forty map sheets on the scale of four miles to one inch, each covering an area of between 5000 and 6500 square miles, and three map sheets on the scale of eight miles to one inch, each covering an area of roughly four times that of a four-mile map, have been compiled from oblique photographs and published. These maps are units of the National Topographic Series, which is designed to cover eventually the whole area of Canada. In the same time twenty-one sheets of the same series, compiled in whole or in part from vertical photographs, have been published on the scales of one mile or two miles to the inch. In addition, seven other map sheets compiled from vertical photographs have been issued.

DISCUSSIONS are proceeding in Hong Kong as to the possibility of establishing a local aviation company to make a beginning with aerial development by running a "shuttle service" connecting Hong Kong with the French and Dutch air mails to Europe.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Position Unchanged.

THERE has been no evidence this week of any decisive change in the trade situation in the Midlands and Staffordshire. Business remains relatively slow in nearly all branches and few works are engaged to capacity. The heavy engineering industries and the iron and steel-producing works are making but slow progress, but improved output is possible in some of the lighter trades. Automobile engineering is a little better and there is some additional movement in the machine tool trade. This latter may be a hopeful augury. Makers of heavy edge tools report fair conditions, and the boiler, tube and nut and bolt and fencing industries in this area record no change from recent trade volume. The hardware and hollowware manufacturers in Staffordshire and East Worcestershire say business is keeping up moderately well, and makers of aluminium wares anticipate improved business as a result of the lifting of the embargo on aluminium imports into Australia. That country was an excellent market for aluminium goods until the embargo was put on, and firms in South Staffordshire which have experienced a big shrinkage of business since are now expecting to be able to recover some, at least, of the ground lost. Demand for iron and steel is on recent levels. Production is in excess of market requirements, but values on the whole remain firm. The tone of the Birmingham iron market is one of anticipation and sellers are hopeful of a growing buying movement as the autumn advances.

Pig Iron Prices.

Selling prices of Midland brands of pig iron were due for revision by the Central Pig Iron Producers' Association to-day—Thursday—but at the time of writing the decision arrived at was not known. The dullness of the market at date and the bulky nature of stocks at the blast-furnaces led the market to anticipate that the present scale of prices would be reaffirmed. It was not considered likely under existing conditions that prices would be advanced, while it was equally unlikely that smelters would see their way to make any reduction with consumptive demand at such a low level Orders for pig iron have been, if anything, slightly better this week. Producers in this area are receiving moderate specifications from the makers of light castings, but engineers are still very short of business, and there is no improvement in the aggregate tonnage absorbed by the heavy ironfounders. Forge material is in very poor request. The tonnage of current foundry iron specifications is low, orders rarely relating to anything beyond material required for immediate consumption. Derbyshire and Northamptonshire blast-furnacemen continue production at the same rate as during the past few weeks.

Steel.

There is as yet no indication of improvement in the finished steel trade in this area, and in the general position there is little of an encouraging nature. Orders against contracts are small for all classes of material, whether finished or semi-finished, while the dullness of the constructional engineering trade persists. The small business done is negotiated at the prices fixed by the Association. Angles cost £8 7s. 6d. per ton, less 15s. to users of British steel only; tees are £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, £8 17s. 6d., less 15s. Boiler plates, prices of which are not controlled, are quoted steadily at £8 7s. 6d. to £8 10s. Chief interest in the half-products market centres in the Continental position. Values of foreign steels have advanced, while in some cases quotations have been withdrawn altogether. Local steelmasters are hoping to profit by the present circumstances. In one or two instances it is now possible to procure supplies of native material at a lower price than that demanded for Continental material. The pity is that consumptive demand at the moment is so low and stocks of foreign steel are so high. Midland re-rollers quote small steel bars re-rolled from foreign billets at £6 7s. 6d. to £6 10s. They are evidently making an effort to raise the price on the ground that their raw material is becoming more costly. For all-British bars they still ask £7, or upwards. Billets remain on the level of £4 17s. 6d. to £5 7s. 6d., while sheet bars are £4 15s. to £5 2s. 6d. Imported sheet bars were quoted early this week at £4 14s. 6d. delivered. Birmingham merchants have not experienced any expansion of inquiries or orders since the hardening of the Continental market. Most of their customers in the Midlands have stocks available for any emergency. Merchants who handle steel scrap complain strongly of the unremunerative level of prices. It is scarcely worth while, they contend, contracting business on the present basis.

Galvanised Sheets.

The recent increase in the cost of spelter and the greater unanimity amongst manufacturers is believed to be mainly responsible for the further upward movement of galvanised sheet prices. The announcement that the Association had fixed the basis for 24 gauge corrugated sheets at £10 a ton, hardly took the market by surprise, though the rise of 10s. per ton after two recent advances of half-a-crown was, perhaps, rather more than buyers had expected. The flow of business has not been materially affected by the change, but it is as yet too early to decide whether the consumer will be willing to support the advance in price. Foreign competition in overseas markets is very keen, and millowners in the present state of trade cannot well afford to lose any ground. Local mills are only moderately engaged at date.

Manufactured Iron.

The situation in the finished iron trade in Staffordshire is unaltered. Output and demand are as recorded in my letter a week ago, and the outlook has undergone no important change. Values are held at recent levels, marked bars being £12 at makers' works, Crown bars £9 upwards, nut and bolt bars £8 upwards, fencing bars £7 15s., and iron strip £10 7s. 6d. to £10 10s. delivered. Although Belgian No. 3 iron is definitely higher in price, it is still cheap enough to compete successfully with common iron bars made in the South Staffordshire district.

The B.I.F.

According to an official message the Birmingham section of the forthcoming British Industries Fair at Castle Bromwich appears likely to surpass all previous Fairs. There has already been a rush of applications for space, and a further 2 acres of land has been allocated to the "outside" section. Each year since the inauguration of the Exhibition extensions to the show space have had to be made, and the available space has always been fully taken up. It is stated that manufacturers are confident that the Ottawa agreements will lead to improved trade, and they wish to take the opportunity the Fair affords of getting into touch with prospective overseas buyers. Well-known firms, which have never shown before, have this year applied for space, for it is believed that by the time the Fair is held trade will have materially improved, and there will be good business to be had.

Coal Gas Experiments.

For some time past the Birmingham Corporation Gas Department has been carrying out experiments having as their object the utilisation of town's gas for the running of heavy motor vehicles. The responsible Government Departments having now given their approval, a scheme for the placing of vehicles carrying gas compressed in steel cylinders on the road is to be carried into effect. A start is to be made with a 20 H.P. goods van. In view of the recent increase in the cost of petrol, the experiments are of vital interest, and it is estimated that compressed gas costing 9d. will give the same mileage for a vehicle as a gallon of petrol costing 1s. 7½d. Originally the Home Office stipulated that the pressures should not exceed 2000 lb. to the square inch, but pressures are to be allowed up to 3000 lb. A plant for the compressing of gas has been installed at one of the works of the Birmingham Gas Department, and arrangements are being made for the provision of filling stations in various parts of the country.

New Telephone Exchanges.

Wolverhampton's new automatic telephone exchanges, composed of 6000 lines, was brought into service on Saturday last. The automatic area comprises one main exchange with 3100 lines at Wolverhampton, where sixteen manual operators' positions are provided in addition, and five satellite exchanges. These satellite exchanges are: Bilston, 700 lines; Fallings Park, 400; Finchfield, 200 lines; Penn, 900 lines; Tettenhall, 700 lines.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER.

Growth of Mechanised Mining.

AN appreciable expansion of the use of machinery in coal mines in the North-West Division of the country, which embraces the Lancashire and Cheshire, North Staffordshire, and North Wales fields, is indicated in the report for 1931 of Mr. W. J. Charlton, the Divisional Inspector of Mines. The percentage of machine-mined coal during the year was 40·2, compared with 35·1 in the previous year, and the amount handled by conveyors was 32·5 per cent. of the total production, against 26·2 per cent. in 1930. The actual output of coal in the division last year declined to 22,592,508 tons from 23,898,800 tons in 1930, the average number of persons employed falling to 110,565 from 117,739 in the previous year. Another interesting development to which Mr. Charlton draws attention is the increasing employment in the coal mines of the area of steel for underground purposes, and both in steel props and steel straps the number in use at the end of last year represented an important increase compared with twelve months before. Allowing for the smaller number of men employed, there was a welcome decline in the number of fatal as well as non-fatal accidents. Discussing accidents resulting from falls of ground at the working face, Mr. Charlton asserts that the risk of injury or death is no less where the coal is machine-mined than it is with hand-mining.

Reducing Factory Smoke.

A technical course, arranged for workmen in charge of factory boiler plant, has been introduced into the winter syllabus of the Manchester College of Technology. Mr. S. M. Duguid is in charge of the course, the classes being held in the evening, and the fee being little more than nominal. Formerly the course was designed to meet the needs of locomotive engine and stationary steam boiler practice, but, in conjunction with the Regional Smoke Abatement Society, it has been extended in the direction indicated. The ultimate object of the course is fuel economy, combined with smoke prevention, on industrial boiler plant, and with this end in view the nature and uses of coal and other fuels, the design of various types of boilers, and the composition and cause of smoke come in for close study. The course in question starts on Monday next.

New Boiler Plant for Manchester Electricity Works.

The Electricity Committee of Manchester Corporation, at its meeting last week, approved a scheme, at an estimated cost of £75,000, for the installation of new boiler-house equipment at the Stuart-street power generating station. Eight boilers that were installed thirty years ago are to be replaced by two water-tube boilers supplied by J. Thompson (Wolverhampton), Ltd., Wolverhampton, and new ash-handling plant is also to be installed. An

indication of the growing use of electricity was furnished to the Committee by Mr. H. C. Lamb, Manchester's chief electrical engineer, who stated that during the first five months of the present year the number of applications for electricity supply was 15,250, an increase of about 80 per cent. compared with the 8449 applications received by the department in the same period of 1930.

Non-ferrous Metals.

All sections of the non-ferrous metals market, with the exception of spelter, have further moved up to some extent, although in each case current values are well below what they were three weeks ago on the eve of the last sudden decline. Tin has been a widely fluctuating market, and at one time values were seriously depressed. Outside influences rather than any actual improvement in demand for the metal resulted in a recovery, and although the highest prices touched during the week have not been maintained, quotations current at the moment of writing represent an advance on balance of about £2 per ton. A better inquiry for copper from consuming interests has been reported, and prices, after a series of ups and downs, are higher in the case of standard brands by between £1 5s. and £1 10s. per ton. So far as actual business is concerned, there has been no special feature about the lead market, but values have moved up to the extent of a further 5s. per ton. A better call for spelter, principally from the galvanising trade, has been experienced during the past week, but in spite of this prices have reacted a little, quotations being lower by several shillings a ton compared with those current a week ago.

Iron and Steel.

The news of a settlement of the strike in the Lancashire cotton industry has had the effect of infusing a certain amount of cheerfulness into most markets in this district, including iron and steel, although up to the present it has not stimulated buying interest. In the foundry iron section the demand this week has been on a relatively small scale, and where replacement contracts are necessary, users are only ordering for a month or so ahead. The complaint of makers is that deliveries are not so extensive as they ought to be, although there is hope that some improvement in this respect will be experienced before long. For delivery in the Manchester area, Derbyshire, Staffordshire, and Cleveland brands of No. 3 foundry iron are maintained at 67s. per ton, with Northamptonshire iron at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at about 84s. 6d., and West Coast hematite at 81s. Bar iron is a steady market, although still only in quiet demand; Lancashire best bars are at £10 5s. per ton; and Crown quality material at £9 15s. Lancashire structural engineers find private work too scarce to keep them anything like busy, and they are hoping that before long it will be found possible to relax the present restrictions on public expenditure. The demand for sections, plates, and bars, as it has been for some time, is limited to small parcels. Acid and basic boiler plates are quoted at about £8 10s. per ton, small re-rolled bars at from £6 15s. to £7, according to quantity, general plates at £8 17s. 6d., sections at £8 7s. 6d., joists at £8 15s., and large diameter bars at £9 7s. 6d. A little more activity has been reported in Continental products, with imported semi-finished materials displaying a firmer tendency.

BARROW-IN-FURNESS.

Hematite.

There is still wanting a better feeling in the hematite pig iron trade. There is an inclination to expect better business in certain quarters, but what is lacking in the market at present is confidence. A certain element is inclined to wait before placing orders, in the hope of a further fall in prices, but this is very unlikely, as iron at the ruling price allows no margin at all. If prices were to stiffen at all, buyers would be in in no time, anxious to cover themselves before a further rise. Stocks of pig iron are coming down, but all the stocks standing at the various works are not for sale, as some is awaiting customers' orders. The Barrow ironworks are still idle, the steel departments taking iron from stock. Iron ore is very quiet. There have been imports of foreign ore recently. The steel market is quiet and few orders are about. The rail mills at Barrow are engaged at present, and so are the hoop and small section mills.

SHEFFIELD.

(From our own Correspondent.)

An Improving Position.

A PROGRESSIVE tendency is now to be found in several sections of Sheffield trade. It is not yet pronounced, but there is every probability that the September turnover will show a moderate advance upon that of August, which was an exceptionally bad month. While transactions are becoming more numerous week by week, they show no improvement in individual value. The absence of bulk buying continues, and work on a retail scale greatly predominates. In the open-hearth section, an additional furnace has been gassed at the United Steel Companies' Ickles works, and one at Samuel Fox and Co.'s, while two or three extra furnaces have been brought into commission at Parkgate. There are no reports of any being set down. A rather better state of things is reported at the rolling mills. The departments producing railway requisites are still very slack, and there is little doing in shipbuilding steel.

Work for the Navy.

There has been a small amount of armament work on hand in the city during the greater part of this year. The carrying out of the Government's present naval programme will not bring much heavy work to the city, but it is sure to absorb a large amount of special steels and metal alloys, which will have to be obtained from Sheffield. The orders may not represent any great tonnage, but the materials are very expensive, and a large sum of money will be involved. There has lately been marked development in heat-resisting and corrosion-resisting metals, bullet-proof plates, and so forth.

Lighter Trades.

A large amount of employment is provided in the city by the requirements of the automobile manufacturers, and the stainless and heat-resisting steel departments are also busy. The demand for cold-rolled steel strip and best wire is well maintained. The crucible steel branch is very flat, but a fair request is found for some kinds of special steels. There is a good trade, both home and export, in Sheffield-made alloys suitable for aeroplane construction. Fairly brisk business is being done in twist drills and cutters, and various mechanics' tools. The serious conditions existing in various overseas countries are hindering a general and substantial revival of Sheffield trade, and other influences of the same character are the holding up of public works nearly all over England, the Irish dispute, and the cotton trade difficulties. On the whole, local trade is patchy, and, while some firms have a fair amount of work on hand, many of them are running at about half capacity.

Magnet Progress.

One of the healthiest of the lighter trades of the city is that of magnet manufacture, for wireless and other electrical uses. The industry, at first largely devoted to the supply of magnetos for motor cars, has been greatly developed since the introduction of the permanent magnet moving coil speaker. The last month or two has seen the placing of several orders for from 5000 to 10,000 lots, and there is a constant stream of smaller orders, so that altogether the works engaged on the manufacture of these goods have had a fairly good run since the spring. A new development is the cadmium-plating of the magnets, instead of lacquering. This gives the magnets a non-rust quality at a small cost, as compared with other non-rust platings.

Effect of Falling Prices.

The principal local company report of the past week was that of Thos. W. Ward, Ltd. It is a document which has both its satisfactory and unsatisfactory features. It is pleasing to read that, notwithstanding a period of unprecedented adverse trading conditions, the year's ordinary trading has shown a profit. On the other hand, owing to the continued fall in prices, the directors have considered it a wise policy again to write down stocks considerably, and the net result is a loss. The profit and loss account shows a debit balance of £23,604. The corresponding figure of loss for the previous year was £62,795, and the reserve fund was drawn upon to the extent of £100,000, the dividends on the preference and employees' shares being paid. It is now proposed to transfer from the reserve fund £10,000, which will enable a sum of £18,288 to be carried forward. Another announcement of the week is that of Edgar Allen and Co., one of the city's most prominent engineering firms. The directors state that, in view of the continued uncertainty of trade conditions, they consider it still necessary to conserve the company's financial resources in every possible way, and that the dividend on the preference shares for the half-year ending September 30th will be deferred. The dividend is paid up to March, 1931.

Sheffield's New City Hall.

There are several features of engineering interest about the magnificent new City Hall which Sheffield has just built at a total cost, including organ, furnishing, and decoration, of £443,686, and which was formally opened by the Lord Mayor last week. The architect was Mr. E. Vincent Harris, F.R.I.B.A., of London. The building contains six halls, which together will hold 5500 people, the largest being a great Oval Hall, which has accommodation for 3000. This hall measures 130ft. by 100ft., and has two semi-circular balconies, which stand without the support of any pillars whatsoever. It has no windows, and is illuminated, whether naturally or artificially, by means of a huge skylight in the roof. In the reinforced concrete construction of the building, between 40,000 and 50,000 tons of material were embodied, including upwards of 1000 tons of steel supplied by the United Strip and Bar Mills. The entire roof is supported by two single-span ferro-concrete beams, each of which is 104ft. long, 14ft. deep, and 13in. wide, and has a weight of approximately 150 tons. The distance from centre of beam to pavement level is 78ft. 6in. Each beam contains 2200 cubic feet of concrete and 12½ tons of steel bars. The principal steel bars are from 45ft. to 55ft. long and 1¼in. in diameter. The heating and cleaning apparatus was supplied by the Brightside Foundry and Engineering Company, Ltd. The method of generating the heat to feed the panel system of heating is by means of three semi-loco. hot-water boilers, the water from which passes through copper tubes in the calorifiers, and by this method the transmission of heat from the water in the tubes warms the surrounding water. The water from the body of the calorifiers is thermostatically controlled, so that excessive temperature cannot possibly be obtained. The whole of the water for this system is accelerated by means of electric motor-driven pumps. For the supply of hot water to the various points of draw-off, a sectional boiler which supplies a calorifier with hot water has been installed. For cleaning the building, two vacuum cleaning plants have been provided and installed.

Cutlery and Plate.

September is usually a very active month in these industries, but the amount of trade has been far below the normal, although the month has been considerably busier than August was. Only a few firms are able to report that they are doing better than a year ago, or even as well. There is a patchy character about the home trade, which is lacking in bulk. At present, shopkeepers are not inclined to discuss the placing of orders for the Christmas trade. Inquiries regarding that special season trade are coming in from Australasia, and orders will soon be in execution. Prospects in these markets, however, are not encouraging, owing to the restrictions upon imports and currency exports. The safety razor blade branch maintains a large amount of activity, and scissors making is also brisk. Many inquiries are about for great quantities of extremely cheap knives, spoons, and forks. One of these, from India, asks for stainless dessert knives with white handles at a price of not more than 3s. 9d. per dozen.

The Late Mr. John Little.

The death of Mr. John Little, which occurred at Southport last Friday, at the age of about seventy, removed a man who for many years occupied a prominent position in Sheffield steel and engineering circles, and who had had an interesting career. He had 54¼ years' continuous service with the firm of Cammell Laird and Co., Ltd., beginning when thirteen years old and retiring two and a-half years ago. He was first an office boy at the Cyclops Works, Sheffield, where his father was foreman patternmaker. At fifteen he went into the pattern shop himself, as apprentice, and when just out of his teens he passed up to the drawing-office. A few years later he was appointed assistant chief engineer; in 1902, chief engineer; six years later, general manager of the Grimesthorpe Works. He left Sheffield in 1918, to take up the position of representative of the firm in the Manchester and Liverpool districts, with headquarters in Manchester and residence in Southport, and he retired in March, 1930. He had a long and interesting connection, as both student and teacher, with technical education in Sheffield, was one of the founders of the Sheffield section of the Junior Institute of Engineers, and its President two years, and also held the presidency of the Sheffield Branch of the British Foundrymen's Association.

NORTH OF ENGLAND.

(From our own Correspondent.)

New Tyne Graving Dock.

WORK for a considerable number of men will be provided by the construction of a new graving dock, with which Swan, Hunter and Wigham Richardson, Ltd., of Wallsend, have decided to replace their present floating dock. The name of the successful contractors has not yet been stated, except that they are a firm well-known throughout the country. Work will begin shortly and will extend over about eighteen months. The new dock will be situated near the firm's other two graving docks at Wallsend, and will be capable of accommodating the biggest vessels visiting the Tyne. It is understood that Messrs. Swan, Hunter are expecting to receive an order for a new vessel in the near future. Following the announcement of the recent Admiralty contracts for destroyers, the news of further activity is extremely encouraging to the Tyneside district. The train-ferry, built for the Chinese Government, on an order given by the Chinese Purchasing Commission in London, will be launched from the Walker yard of Messrs. Swan, Hunter on October 12th. The vessel, which has cost £70,000, will be launched by Mrs. Quo Tai Chi, the wife of the new Chinese Minister, and will be named "Changkiang." She will leave the Tyne under her own steam early in the New Year for Nanking, and will be used for conveying trains across the Yangtse a month or two later, when the bridges and approaches are ready. The work of building the vessel began early in the year.

Plan to Open Railway Shops.

Much interest is being taken on Tyneside in the efforts to keep open the Gateshead railway shops, which the L.N.E.R. Company has decided to close down. The scheme now being considered is that the shops should be run by an engineering firm for the manufacture of locomotive engines for export, and this, it is understood, can be brought into operation if the financial position can be solved. There are prospects of an order being obtained which would enable a start to be made with the project, and hope, at present, seems to lie in the possibility of inducing the Government to allow export credit facilities. The railway company has intimated that the shops will be leased on favourable terms to anyone who will run the works.

Coal Contract by Barter.

The Swedish State Railways' order for 37,000 tons of steam coal and 2000 tons of bunkers has been secured by a Newcastle exporting firm on the understanding that pit timber is taken in exchange. This is unusual so far as the Swedish railways are concerned, but unknown with other contracts. The same firm negotiated similar contracts some time ago, having supplied 95,000 tons of coal to the Finnish Railways, timber being taken in return. The coal for the Swedish railways has to be shipped in specified quantities to named ports in the last three months of the year. The North-East is also to share in a substantial way in an order for 100,000 tons of locomotive coal for Denmark. Agents there who are handling coal and fuel for this district report a steady increase in the number of inquiries. At one time particular preference was shown by Danish importers for East Northumberland coal. Through Polish competition, however, Northumberland pits have been hard hit by their old customers going elsewhere. It is understood that the allocations of the Danish order are: 45,000 tons South Hetton coal; 7500 tons Horden, and 9000 tons Broomhill. Of the balance of requirements, 20,000 tons is stated to have gone to Scotland, and 20,000 tons to Westphalia.

Cleveland Iron Trade.

A much better atmosphere prevails in the Cleveland pig iron trade, and there is a feeling of confidence that the corner is being gradually turned. Whilst it is true that actual business transacted is limited in amount, there is, nevertheless, a greatly improved tone, with inquiries circulating more freely, both for home and overseas. Orders are coming to hand more regularly, and should they expand there is no doubt that present

stocks will soon be moved. Continental markets have stiffened, and this should be to the benefit of producers in this district. Cleveland makers have not varied their prices locally, but are still selling at cut rates to Scotland, and are understood to have accepted below the official minimum for overseas business. The fixed local quotations are: No. 1 foundry, 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d., and No. 4 forge, 57s.

Hematite Pig Iron.

Business in East Coast hematite pig iron is brisker than for a long time past, and the Skinningrove Iron Company has changed one furnace from the production of Cleveland iron to that of hematite. There are now six furnaces in the district on the manufacture of hematite. Most of the output is going into immediate consumption, and makers are adhering fairly closely to the quotations of 60s. for mixed numbers, and 60s. 6d. for No. 1 quality.

Ironmaking Materials.

The foreign ore trade is still quiet, but odd cargoes are stated to have been sold at a price equal to 14s. 6d. c.i.f. for best Rubio. Blast-furnace coke is a dull market, and supplies can still be obtained at 14s. 6d. delivered at the works, though some of the producers hold out for better terms.

Manufactured Iron and Steel.

A further shipment of 600 tons of steel rails was made to Canada from the Tees this week. The vessel also carried between 500 and 600 tons of steel plates and angles. This is the first time for many years that Teesside iron and steel manufacturers have been able to compete with American manufacturers in the Canadian market. Further shipments of steel rails to Canada are expected from Teesside shortly. There is a little more life in this section of industry, thanks to a better overseas demand. The sheet makers have lately also had better opportunities of booking orders, and the price of galvanised has advanced to £10 per ton. Other quotations are unchanged.

The Coal Trade.

The position in the Northern coal trade is much brighter, with bookings expanding over the next few weeks. It is largely home trade, but there are signs of more buying from abroad. Seasonal business is coming on more actively and there is a feeling that buying is on the increase. A fair volume of business is passing in the Northumberland steam coal section, and in all grades the undertone is steadier. The better tone, however, has not so far been translated into higher prices, though recent values are quoted firmly. Best steams are 13s. 6d., small 8s. 8d., special Wear large 15s. to 15s. 1½d., with small firmly held at 11s. to 11s. 1½d. Tyne primes move steadily at 12s. 9d., and small are firm at 9s. There are expectations of better trade for gas coals, and pits in Durham are already working a little more regularly. Best sorts are steadier at 14s. 6d., and seconds command from 13s. to 13s. 6d. Increased bookings and an improvement in the forward demand are steadying bunker qualities, and the tone is much more encouraging than for several weeks. Best qualities are firm at 13s. 6d. to 13s. 9d., and ordinary 13s. to 13s. 3d. Durham coking unscreened and smalls are quiet and unchanged at 12s. 6d. to 13s. 3d. Substantial booking and a well-sustained inquiry keep a firm tone in the coke market. Best gas for prompt or forward offers sparingly and at a firm 17s. 6d. Patent oven coke is steadier at 14s. 6d., and superior makes at 16s. 6d. Coke nuts are quoted steadily at 16s. to 18s.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE Government orders placed with Clyde shipbuilders last week are especially welcome at this time. It is earnestly hoped that private owners will follow suit and that the yards will become employed sufficiently to give a much-needed impetus to the local steel and iron trades. A number of inquiries have been mentioned, and it is fully expected that some of these will materialise in the near future.

Steel and Iron.

Makers of heavy steel are still very short of orders, and although, of course, work is anticipated in connection with the Government contracts already referred to, something in the nature of a revival in mercantile shipbuilding is required to provide an outlet for a normal production of plates, sections, &c. The works engaged in the production of bar iron and re-rolled steel bars are not employed to anything like capacity. Bar iron is too high in price at £9 15s. home (fixed) and £9 5s. export to induce business, while re-rolled steel bars at £6 10s. home (fixed) and £6 5s. per ton export are hardly competitive, even under present tariff arrangements.

Steel Sheets.

The outlook in sheets is improving owing, in a measure, to orders and better inquiries from the Far East and South America. Mills employed on light sheets are busy, and in some cases are fully employed. Prices of light sheets have been advanced from 5s. to 10s. per ton in view of the advance in Continental semi-products and the possibility of higher costs of raw materials. Heavy sheets are not meeting with the same response as light sheets. Galvanised sheets are not particularly well booked, but export prices have been raised to £11 per ton.

Oil Shale.

Within recent years the output of oil shale has been confined to the Edinburgh and Linlithgow districts. In the year 1913 the output from Edinburgh was over 700,000 tons, and from Linlithgow over 2,500,000 tons. Since 1927 the output from Edinburgh has averaged a little over 200,000 tons, while in Linlithgow the production has fallen from 1,899,213 tons to 1,498,759 tons in 1931.

Pig Iron.

Scottish pig iron makers have not derived much benefit from the recent reduction in prices, and demands are still easily supplied from stocks. During the past week 630 tons of pig iron arrived in this district from Workington.

Iron Prices and Wages.

Wages in the Scottish manufactured iron trade will remain unchanged owing to the fact that the average net selling price of iron during July and August last has been certified at £9 19s. 6·38d.

Coal.

So far as large coal is concerned, the market for Scottish fuel has not shown any improvement. Best Fifeshire steams are the only sort to maintain a firm attitude. Washed nuts, on the other hand, are very strong, especially Fifeshire trebles. Scandinavia, Denmark and Finland are inquiring freely for washed nuts. Aggregate shipments last week amounted to 260,081 tons, against 220,471 tons in the preceding week, and 213,870 tons in the same week last year. Home demands develop slowly. Industrial requirements and domestic demands alike are well below normal. Household fuel has been advanced by 1s. 6d. per ton, but the collieries and merchants may experience considerable difficulty in securing the increased price.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE contrast between the state of the steam and anthracite sections of the coal industry in this district continues to be more marked than ever. At the end of last week there were nearly forty vacant loading berths between Newport and Port Talbot, but at Swansea all berths were occupied, and six vessels were waiting. On Monday of this week, as the result of arrivals of tonnage the position was that at the steam coal loading ports there were thirty-two idle tips, but at Swansea the number of waiting vessels was increased to sixteen. The pressure for anthracite coals is so heavy that it is difficult to cope with it, and there is the prospect that this will be seen for some weeks at least. Certainly while the shipments to Canada are in full swing, the conditions at Swansea will be brisk. Outstanding inquiries for supplies of steam coals are few. The Egyptian State Railways are coming in the market for 60,000 metric tons of locomotive coals, but the tenders for this business have not to be in at Cairo until December 20th. The last contract entered into for their requirements was completed only a week or two ago, and in that case the quantity was altogether 216,000 tons, of which 162,000 tons was arranged on a c.i.f. basis of 24s. 3d. per ton delivered at Alexandria and 54,000 tons was on a f.o.b. basis of 17s. 11d. per metric ton. This contract was secured by T. Beynon and Co., Ltd., of Cardiff. Apart from the above-mentioned inquiry, the Egyptian State Railways have asked for prices for 22,000 tons of sized coals for their power plant, and in this case they want prices by October 3rd. In view of the extremely limited production of sized coals at the present time, this business may be rather difficult to undertake. There are, of course, other and smaller inquiries in circulation, but the amount of new business about is not at the moment substantially greater than has been experienced for some time past, except that in some directions the conditions are slightly better as the result of seasonal requirements. Still leading firms are exploring every possible avenue for business, and this is shown by the negotiations which are proceeding for the supply of coals from this area to the railways in Newfoundland taking in return timber. Business has already been done on these lines between leading firms on this side with Finnish and Swedish State Railways. Returns of shipments from this district show the need for stimulating the demand for steam coals, as last week the figures issued by the Great Western Railway Company reveal that from the ports under their control the total shipments of steam and anthracite coals came to only 388,810 tons, as compared with 416,940 tons for the preceding week, and it must be borne in mind that anthracite shipments alone were last week better than those for the previous week. From this it will be seen that shipments of steam coals were reduced. They were, in fact, lower at every port between Newport and Port Talbot. Unfortunately, the prospects of an improvement are not immediate, as the chartering of tonnage of late cannot be described as having been active. On the contrary, the daily returns show that operations on the outward freight market have been rather more restricted.

Coal Import Quotas, &c.

Reference has been made on numerous occasions to the damaging effect of import quotas and barriers raised by near Continental countries, to the detriment of the coal export trade of this country. Scarcely a week goes by without some news coming to hand which causes some uneasiness in the minds of colliery undertakings and exporters. For some time past all sorts of reports have been coming from France respecting the proposals which were said to be contemplated by that country dealing with the limitation of coal imports and the stipulations which were to be made concerning imported coals being carried in French tonnage. The latest reports, however, rather clear the air, inasmuch as it is now understood that the French Government is not introducing any new regulations as from October 1st which make it imperative that French tonnage should be utilised on a greater scale than exists at the present time. Furthermore, the rumours current that the French authorities contemplate changing the basis upon which the coal import quota is fixed appear to be unfounded, as it is now understood that the import quota for coals from the United Kingdom for the month of October is to continue at 70 per cent. of the average monthly quantities imported during the three years 1928–30. This, however, is in a sense a nominal figure, as the actual working percentage is less—that is, that import licences are actually granted for a quantity that is round about 60 per cent. The French authorities always keep a margin in hand to meet special requirements. A good deal has also been made of the report that the French Mines Department had determined to grant to the Maritime Chambers of Commerce permission to import during October 100,000 tons of coals suitable for domestic purposes. This has been construed in many quarters as an addition to the import quota for coals from the United Kingdom only, but this is not the case. The members of the French Maritime Chambers of Commerce who import coals can place their orders where they choose, and it is by no means certain that even a large part of this extra 100,000 tons will come to this country. France will find it very difficult for the next month or two to secure, for instance, any greater quantities of anthracite coals than they are at present receiving, owing to the collieries being so fully committed, and the same applies very much to semi-anthracite coals, such as dry qualities, of which the sized descriptions are extremely scarce. The news also came to hand last week that Spain intends restricting still further her imports of coal. It has been well known for some time that Spanish coalowners have been pressing upon the authorities the necessity of compelling their consumers to take more native coals and import less. The report which was received last week was that the Spanish Government intends to issue a decree that as from October 1st Spanish railways are to use only native coals. It was even stated that existing contracts for Welsh coals were to be disregarded, but this has since been denied. Up to the time of writing, no official news has been received that a decree has been issued by the Spanish Government, but coal-exporting interests, fully alive to the importance to this district of any further restrictive action on the part of the Spanish authorities, have communicated with the British Government pointing out the urgent need of steps being taken to safeguard the interests of the coal export trade of this district.

Miscellaneous Items.

The Council of the South Wales Miners' Federation decided on Monday to appoint a small committee to co-operate with the Llanharry owners and workmen at the iron ore mines with a view to presenting a case to the Government Committee dealing with quotas. As previously mentioned, there is a danger of these iron ore mines being closed. The Glamorgan County Council regarded it as a dangerous precedent to associate themselves with the movement for protecting the iron ore mining industry, and consequently decided to take no action in response to a request to assist in the matter. The Council of the South Wales Miners' Federation has given the workmen at the Bedwas Colliery permission to tender notices, it being alleged that the management has refused to carry out the arrangements made when work was resumed about a year ago that the whole of the old employees should be re-engaged. It was stated that a number of strangers had been given employment when hundreds of men who had been formerly employed were still idle. The official announcement has been made that the Kidwelly Tinplate Works will restart on Monday, October 3rd. The Whitford Steel Sheet Galvanising Works at Briton Ferry, which belongs to the Grovesend group and has been idle for several months, will also resume operations on Monday, with the result that 500 men will be employed. On the other hand, Messrs. Baldwin's tin-plate works at King's Dock, Swansea, are to close down for an indefinite period. Notices to this effect were posted at the beginning of this month to take effect at the end of September. On Friday of last week the Welsh Parliamentary Sub-committee and leaders of the Back-to-Coal movement had a conference in London with the Minister of Mines, and after a three hours' discussion a sub-committee of the deputation was appointed to collaborate with the Government Departments concerned with a view to a standing committee being set up. The principal purpose of this body will be to link up the industry and research, and to promote the development of schemes to secure the wider utilisation of coal.

Current Business.

The feature of the steam coal section is the firmness of dry sized coals, nuts and cobbles being quoted up to 27s. 6d., which is above the scheduled minima. Production of these qualities is, however, on a limited scale, owing to the comparatively little demand for large coals. Other descriptions of steam coals are comparatively quiet. It is stated that the steam coal production quota for South Wales for the last quarter of this year has been fixed at 56 per cent. of the standard tonnage, which represents a reduction of 10 points, as compared with the quota for the quarter ended September. Patent fuel and coke show no material change, while pitwood is not in better demand, with prices ranging about 19s. to 19s. 6d.

CATALOGUES.

GREENWOOD AND BATLEY, Ltd., Leeds.—Pamphlet No. 116 on a small ball bearing type steam turbine.

SUFFOLK IRON FOUNDRY (1920), Ltd., Stowmarket.—First edition of the new magazine, *Sif-Teps*, to be published quarterly for the benefit of welders.

BAGSHAWE AND CO., Ltd., Dunstable, Beds.—Catalogue No. 107, a book of some 140 pages of illustrations of "B.B." elevators and conveyors of all types.

ENGLISH ELECTRIC COMPANY, Ltd., Stafford.—Pamphlets Nos. 1001, 1002, 1003, on tramcars as supplied to Bombay, Calcutta, and Huddersfield.

DRAYTON REGULATOR AND INSTRUMENT COMPANY, Ltd., West Drayton, Middlesex.—List No. 102c on "V.T." automatic temperature regulators.

SIR W. G. ARMSTRONG, WHITWORTH AND CO. (ENGINEERS), Ltd., Scotswood Works, Newcastle-upon-Tyne.—An illustrated booklet of the firm's products.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/-
(1) Spanish	17/- to 22/6
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 7 6	—
No. 1 Foundry	3 10 0	—
No. 3 Foundry	3 7 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 0 0	3 0 0
No. 1	3 0 6	3 0 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	— *	—
„ „ Foundry	— *	—
(c) Northampton—		
Foundry No. 3	— *	—
Forge	— *	—
(c) Derbyshire—		
No. 3 Foundry	— *	—
Forge	— *	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6(a) / 4 0 6(b) / 4 5 6(c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ½in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	10 0 0	9 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0 to 8 12 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 0 0 to 7 5 0	—
Small Re-rolled Bars	6 7 6 to 6 10 0	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets, f.o.b. L'pool	9 10 0	—
(3) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/9 to 16/-
Block Tin (cash)	151 10 0
„ (three months)	152 12 6
Copper (cash)	34 5 0
„ (three months)	34 7 6
Spanish Lead (cash)	12 13 9
„ „ (three months)	12 15 0
Spelter (cash)	15 1 3
„ (three months)	15 1 3
MANCHESTER—	
Copper, Best Selected Ingots	38 0 0
„ Electrolytic	39 10 0
„ Strong Sheets	68 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	14 17 6
„ Foreign	13 5 0
Spelter	15 5 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/- per lb.	
Ferro Tungsten	1/9 per lb.	
Ferro Chrome, 4 p.c to 6 p.c. carbon	£25 0 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£23 5 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 0 0	11/-
„ „ „ 1 p.c. carbon	£44 10 0	14/-
„ „ „ 0·70 p.c. carbon	£46 0 0	16/-
„ „ „ carbon free	1/1 per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£10 15 0 for home	
„ „ „	£9 15 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£245 0 0	
Ferro Cobalt	7/9 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	12/6
„ „ Ell	14/-
„ „ Splint	13/9 to 14/9
„ „ Trebles	13/6
„ „ Doubles	11/6
„ „ Singles	10/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	11/6
„ „ Jewel	16/6
„ „ Trebles	14/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 12/6
Screened Navigation	16/6
Trebles	16/- to 17/-
Doubles	12/- to 13/6
Singles	10/6 to 11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/- to 11/6
Secondary Steam	10/6
Trebles	14/-
Doubles	12/-
Singles	10/-

(8) N.W. COAST— ENGLAND.

Steams	21/-
Household	32/6 to 52/6
Coke	19/- to 22/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	27/- to 28/- —
South Yorkshire Best	22/- to 24/- —
Derbyshire Best House	22/- to 23/6 —
Derbyshire Best Brights	18/- to 20/- —
Screened House Coal	17/- to 18/6 —
Kitchen Coal	16/- to 17/6 —
Best Screened Nuts	16/- to 17/6 —
Small Screened Nuts	15/- to 16/6 —
Yorkshire Hards	17/- to 18/- —
Derbyshire Hards	17/- to 18/- —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	7/- to 8/6 —
Blast-furnace Coke (Inland)	9/6 to 10/- on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 14/6 to 15/6	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 27/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	20/-
Pitwood (ex ship)	19/- to 19/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/- to 39/6
Seconds	27/- to 34/-
Red Vein	22/- to 26/6
Machine-made Cobbles	37/6 to 48/6
Nuts	36/6 to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	10/9 to 11/-
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

* Under review at the time of going to Press.

French Engineering Notes.

(From our own Correspondent in Paris.)

Hydro-electric Production.

THE falling consumption of electricity for industrial purposes arising out of the depression has not checked activity in the construction of hydro-electric power stations, under the scheme of national electrification. The next two years will see a considerable increase in the quantity of energy available for distribution. At present nearly one-half of the total quantity of electrical energy is produced in the Alps, the Massif Central and the Pyrenees, the remainder, to the north of the river Seine, being supplied by thermal stations and, to an increasing extent, by the collieries which are making full use of their unsaleable poor-quality small coal for steam raising in electrical power plants. All the systems are connected to Paris by 220-kV mains, and the hydro-electric supplies are linked up with the thermal stations. The ultimate phase of the scheme covers the possibility of exporting energy by connecting up the French supplies with the systems in Germany, Italy, and other countries in Western Europe. Next week, the Brommat power station of 180,000 kW capacity will be sending current to Paris by the second 220-kV main which was recently completed. This station is on La Tuyère, a tributary of the river Lot, rising in the Massif Central, where also the Sarrans dam is being constructed to impound 305 million cubic metres of water. This dam will be 150 m. high and 220 m. long at the top, and the power station will have a capacity of 102,000 kW. Like other rivers in the Massif Central, the La Tuyère has occasionally a torrential character, and provision will be made to relieve the dam of any excess of pressure in times of flood by passing the surplus water through two underground tunnels 16 m. in diameter. These tunnels also served to divert the river during the construction of the concrete dam, the foundation of which has been carried down through rock. As the site is completely isolated, and as there are no roads considerable preliminary work had to be carried out in the way of building a village for the workmen and laying an overhead cableway to a town 12 miles away, from which all the material has to be obtained. It is expected that the work will be completed in 1934.

The Pas-de-Calais Collieries.

The coal production in the Pas-de-Calais represents approximately one-half of the total French output, and according to a report just issued by the chief engineer of the "mineralogical arrondissement" of Arras, or the mining area under State survey, the production fell from 25,000,000 tons in 1930 to 23,481,000 tons in 1931. The Pas-de-Calais basin extends from Douai to Fléchinelle, a distance of 43¼ miles, and it comprises twenty-four concessions, while there are three concessions in the neighbouring small Boulogne basin. Last year twenty-one concessions were worked with 186 pits. The report states that the Pas-de-Calais production could easily reach 30,000,000 tons if the colliery companies were assured of disposing of their coal in Paris and the Seine Department by means which would enable them to combat what is called "English dumping." The only way, it is affirmed, of doing so is to construct the Nord Canal from the northern collieries to Paris. This project has been under consideration for the past fifty years, and the canal was, in fact, begun before the war, though work upon it since then has not been resumed on account of the cost and also of the doubtful advantages of such an expenditure when the collieries are so well served by the railways. The canal would probably compel the railway company to reduce freights for coal, but it has yet to be proved that the canal could pay its way. It is also stated in the report that the average depth at which coal is mined in the Pas-de-Calais increased from 363 m. in 1913 to 397 m. in 1930 and 403 m. in 1931. Last year the electrical generating plants at the collieries had a total capacity of 430,985 kW, as compared with 334,435 kW in 1930, and they produced 1197 million kWh, which was notably less than in the previous year.

Motor Car Industry.

The year so far has been a particularly poor one for motor car manufacturers, who have had to take advantage of all holiday and other interruptions to keep the works closed as long as possible. The present time is one of business reorganisation and of negotiation with other countries in the hope of obtaining reciprocal facilities for the sale of cars. It is clear, however, that makers must rely more than ever upon the home demand, which has been seriously affected by the general economic depression. There are more cars running, but owners are making the most of their old vehicles and are not replacing them to a normal extent, and there have been proposals to compel the withdrawal of cars that fail to conform to modern standards on the plea that they are not safe to drive under present traffic conditions. Any attempt to restrict the rights of users to drive old cars would be strongly resented. The policy of makers now is to reduce prices and to extend the system of purchases by instalment, which has already proved an incentive to buying, though involving some risk to the seller, and efforts are being made to get a Bill through Parliament to render the position of sellers more secure in the event of buyers failing to pay instalments.

Tidal Power.

The dissolution of the Société Marémotrice de la Rance recalls the failure to carry out the schemes of several years ago to utilise tidal energy on the coast of Brittany and elsewhere, and produce electricity for distribution in the West of France, which is otherwise deprived of natural sources of energy. The company formed with international capital and the support of electrical engineering firms to install an experimental station at Aber W'rach, near Brest, for the State with the aid of State subsidies started operations, but suspended them when Parliament failed to vote the credits which were promised for the undertaking. Since then nothing has been done, and in present circumstances there seems to be extremely small hope of the Government being able to devote money to this experimental scheme.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

379,169. December 2nd, 1931.—ENGINES WITH VARYING COMPRESSION SPACES, O. S. Ruud, Torvgate 2, Oslo, Norway.

In this engine the compression space is varied according to the load by altering the length of the connecting-rod. The rod, it will be seen, is made in two parts A and B, which are interconnected by the lever C. This lever is pivoted on the crank pin D, which is held by the connecting-rod E of the cataract cylinder F. The cylinder is supplied with oil by the gear pump G, and this oil is returned to the crank case through the spring-loaded valve H in the piston of the cataract cylinder. The operation is as follows:—As long as the engine is running at normal load and speed a constant and regular flow of oil from the pump G through the cataract cylinder into the crank casing takes place. The spring J in the cylinder tends to close the valve H and depress the cataract piston. Moreover, the oil exercises a downward pressure on the cataract piston. According to its value the oil pressure causes more or less frequent opening of the valve H. The cataract piston therefore acts upon the rod E, and accordingly upon the lever C and the crank D in the manner of a resilient resistance, the value of which depends upon

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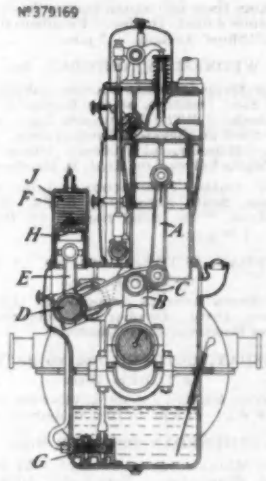

the oil pressure and the tension of the spring J. In the compression stroke of the engine piston the compression ratio is determined by the resistance of the cataract piston. On the succeeding explosion the pressure exercised on the engine piston may become so great that the cataract piston yields, so that on the next upward stroke of the engine piston a lower top position is obtained. The volume of the compression space is thus altered for the next explosion. If the load remains unaltered also the volume of the compression space remains unaltered. If a greater quantity of mixture is admitted to the engine cylinder the combustion pressure overcomes a part of the resistance of the cataract piston, so that the cataract piston is displaced upwardly and causes an alteration in the angular position of the lever C. This causes a decrease of the distance between the main piston and the crank pin and thus an increase of the compression space. At the same time the spring action upon the valve H is increased by the increased compression of the spring J, so that the total resistance of the cataract piston is increased. Thus the resistance adjusts itself automatically to the load.—*August 25th*, 1932.

TURBINE MACHINERY.

379,263. May 9th, 1932.—STEAM TURBINES, *International General Electric Company, Incorporated*, 120, *Broadway, New York, U.S.A.* (assignees of Allgemeine Elektricitäts-Gesellschaft).

In order to economise floor space the inventors arrange multi-stage steam turbines one above the other and support the whole

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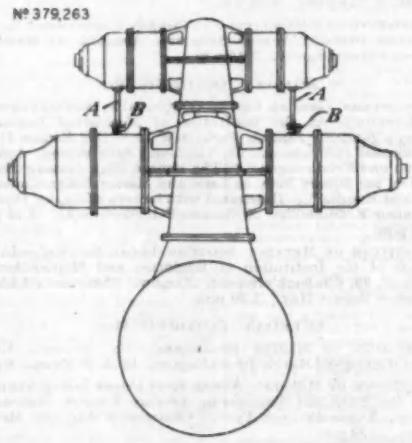

assembly on the condenser. The drawing shows a two-stage arrangement of radial flow turbines working on the Ljungström principle. The generators of the high-pressure system, which is the upper, are supported by props A A, incorporating springs B B, to accommodate changes of temperature.—*August 25th*, 1932.

379,264. May 10th, 1932.—STEAM TURBINES, *G. R. Shepherd*, 2, *Norfolk-street, Strand, London, W.C.2.*

In large steam turbine units the difference in absolute pressure at the inlet to the condenser, and on the corresponding area of its shell subjected to atmospheric pressure, may be so great as to nullify the flexibility of any joint arranged between the turbine exhaust and the inlet to the condenser for the purpose of accommodating thermal expansion and contraction. As a

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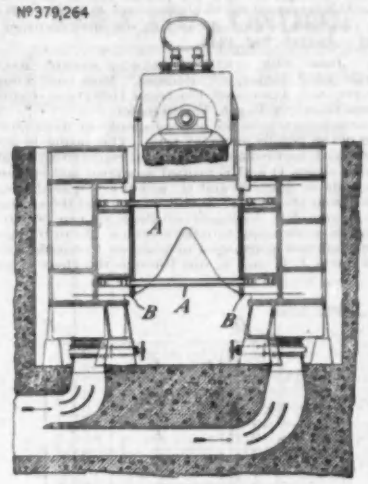

consequence, the inventors bifurcate the exhaust, as shown in the illustration, and discharge the steam into two opposed condensers of the vertical type. The force tending to close the two condensers, one towards the other, is taken by the struts A, A, so that the flexible joints B, B remain free.—*August 25th*, 1932.

DYNAMOS AND MOTORS.

378,912. May 16th, 1931.—DYNAMO-ELECTRIC MACHINES, Allgemeine Elektricitäts-Gesellschaft, of 2–4, Friedrich Karl-Ufer, Berlin, N.W.40, Germany.

A system is known whereby three-phase stator excited commutator machines connected in cascade with asynchronous machines have series and external excitations. The series excitation serves to render the rotating field of the three-phase commutator machine dependent upon the load on the main machine. Apparently, the main object of this invention is to reduce losses due to resistance. An example of the usual scheme is described, and illustrated, but it will suffice to deal with the scheme that forms the subject of the invention. A is the compensating winding, C the series exciting winding, and B the externally

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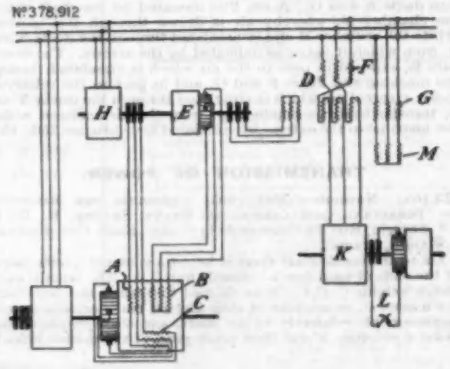

excited exciting winding of the secondary machine. The exciting current of the winding B is obtained from the network *viâ* the current transformer D and the frequency transformer E. The current transformer D is provided with two primary windings F and G. The winding F serves to regulate the speed of the main machine H or for regulating the active load of this machine when the speed is fixed. Regulation is effected by varying the excitation of the synchronous motor K, running at no-load, by means of the variable resistance L. The winding G is employed for adjusting the reactive load. The current passing through the winding G is determined by the choke coil M, which may be regulated in any desired manner, such as by varying the number of turns, altering the air-gap, or by connecting single coils in parallel.—*August 16th*, 1932.

378,975. May 22nd, 1931.—ELECTRIC MOTORS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C.2, and Arthur Hemborough Maggs, of "The Briars," Wellsway, Keynsham, near Bristol.

The application of a condenser as a phase splitting device for starting single-phase induction motors of small power and for improving their running characteristics is well known. The motor is usually wound two-phase and the condenser is put

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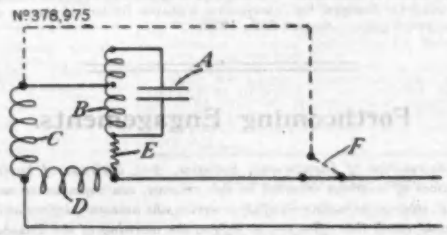
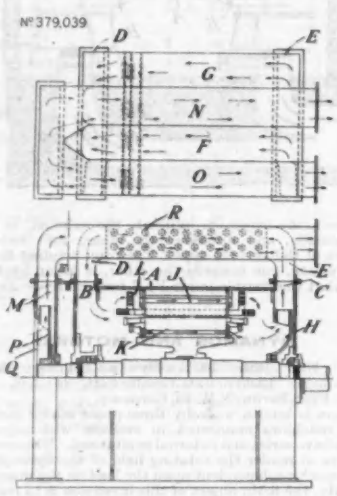


in series with one of the phases, either directly or through an auto-transformer. Frequently, the condenser phase has a different number of turns from the main phase. The present invention consists in the application of a condenser as a phase-splitting device to a variable speed shunt commutator motor of the double-brush shifting type. A condenser A is connected through an auto-transformer B, in series with one phase C of the primary of a commutator motor wound two-phase in which phase C may have the same or greater or smaller number of turns than phase D. The secondary and regulating windings, which are similar to those of the well-known polyphase motor, are omitted for simplicity. A resistance E may be inserted in series or parallel with the condenser to modify the charac-

teristics of the motor as desired. The switch F may be inserted with an alternative connection shown dotted where reversing is desired, but in this case phases D and C would generally require to have the same number of turns, although this is not essential if different characteristics for each direction of rotation are required. If necessary, however, the rotor may be provided with four slip-rings, so that the phases can be kept separate and phase C be reversed relatively to phase D, in the well-known manner. Another method of carrying out the invention is also described.—*August 22nd*, 1932.

379,039. June 30th, 1931.—DYNAMO-ELECTRIC MACHINES, Gustaf Adolf Juhlin, of "Redscar," Moss-lane, Timperley, Chester, and Associated Electrical Industries, Limited, of Crown House, Aldwych, Westminster.

This invention relates to improvements in dynamo-electric machines of the totally enclosed type. The casing is provided at its ends with vertical spouts B and C respectively, communicating with chests D and E formed as shown and opening into opposite ends of ducts F and G, which are spaced from each other and from the casing. It will be seen that the arrangement provides a complete enclosure in which air can be circulated for cooling the working parts of the machine. A fan H is mounted upon the shaft and is arranged to cause air to circulate through the vent ducts J, K and L, out through the chest E into the

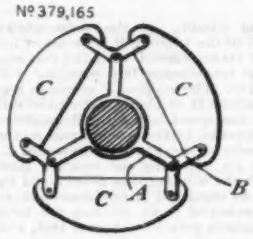


ducts F and G, whence it is returned through the chest D as depicted by the arrows. The machine shown is provided at the left-hand end with a chamber M, which is provided with a vertical spout portion which communicates with a chest opening into ducts N and O. A fan P is mounted on the shaft within the chamber M, whereby air is drawn through the aperture Q into the chamber M and is circulated through the ducts N and O, from which it issues as indicated by the arrows. The finned bars R, exposed in part to the air which is circulated through the machine and ducts F and G, and in part to the relatively cooler external air which is circulated through the ducts N and O, transfer heat, by conduction, from the air enclosed within the machine to the externally circulated air.—*August 25th*, 1932

TRANSMISSION OF POWER.

379,165. November 30th, 1931.—DEVICES FOR REDUCING TORSIONAL OSCILLATIONS IN CRANK SHAFTS, R. R. R. Sarazin, Rue du Chateau de la Chasse, Saint Prix (Seine-et-Oise), France.

On to the crank shaft there is keyed a spider A which carries at the ends of each arm a "double link" B. The links B carry heavy weights C, C, C. It is claimed that when the shaft turns the masses C, on account of their inertia, make certain angular displacements relatively to the shaft, and these displacements cause a pivoting, about their pivot pins, of the double links B,



the arms of which always remain parallel in pairs. These displacements of the masses C relatively to the shaft have the effect of counterbalancing the natural inertia of the shaft, and of ensuring on the latter a reaction of suitable direction adapted to reduce the torsional oscillations of the shaft. The masses C behave like a negative inertia. It should be noted that in all the positions of the masses C relatively to the shaft the device as a whole is balanced. The angular displacements of the masses C may be damped by interposing suitable frictional means on the pivot pins.—*August 25th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, OCTOBER 1ST.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Openshaw Junior Technical School, Garton-road, Manchester. Presidential Address by Mr. Ellis Flower. Paper "Why Educate the Foundryman?" by Mr. S. P. Howden. 4 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Visit to Kingsbridge and Salcombe Water Board's Works. Meet at South Brent Station, G.W. Railway. 2 p.m.

MONDAY, OCTOBER 3RD.

BRADFORD ENGINEERING SOCIETY.—In the Hall of the Bradford Technical College, Bradford. Presidential address, "Heavy Oil Engines," by Mr. H. Akeroyd. 7.30 p.m.

CHEMICAL ENGINEERING GROUP.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, W.1. Jubilee Memorial Lecture, "The Corrosion of Metals in Salt Solutions and Sea-water," by Dr. G. D. Bengough. 8 p.m.

CLEVELAND INSTITUTION OF ENGINEERS.—Joint meeting with the Iron and Steel Institute, Cleveland Technical Institute, Middlesbrough. "Metallurgical Problems Arising from Internal Combustion Engine Valves," by Mr. J. R. Handforth; "Generation of Steam from Blast-furnace Gas," by Mr. A. F. Webber. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C.2. "The Elimination of Reflections from Glazed Pictures in Galleries," by Mr. Robert Howden. 3 p.m.

SOCIETY OF ENGINEERS.—In the Apartments of the Geological Society, Burlington House, W.1. "Meat Canning Factory and Bridge Construction in Central Africa," by Mr. J. R. Paris. 6 p.m.

TUESDAY, OCTOBER 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C.2. Presidential address, "Legislation and the Automobile Engineer," by Major C. G. Nevatt. Presentation of awards. 8 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—In the Lecture Room at the Home Office Industrial Museum, Horseferry-road, Westminster, S.W.1. Autumn special meeting. "The Measurement, in Relation to Human Comfort, of the Radiation Produced by Various Heating Systems," by Dr. H. M. Vernon. 6.45 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Silicates in Steel," Professor J. H. Andrews. 7.30 p.m.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—The Education Offices, St. James's-road, Dudley. Presidential Address, Mr. A. E. Osborn, "Ships' Anchors." 7 p.m.

WEDNESDAY, OCTOBER 5TH.

MANCHESTER METALLURGICAL SOCIETY.—Joint meeting with the Iron and Steel Institute, at the Engineers' Club, Albert-square, Manchester. "The Endurance Limit of a 0·33 per Cent. Carbon Steel at Elevated Temperatures," by Mr. J. W. Cuthbertson; "Metallurgical Problems Arising from Internal Combustion Engine Valves," by Mr. J. R. Handworth. 7 p.m.

SOCIETY OF GLASS TECHNOLOGY: LONDON SECTION.—Science Museum, South Kensington, S.W.7. Annual general meeting. Address, "The Solid State," by Professor C. H. Desch, F.R.S. 7.30 p.m.

WEDNESDAY, OCTOBER 5TH, TO SATURDAY, OCTOBER 8TH.

ELECTRO-FARMING AUTUMN SCHOOL.—At Greater Felcourt, East Grinstead. Daily. October 8th, Conference at Greater Felcourt School Buildings, East Grinstead.

WEDNESDAY, OCTOBER 5TH, TO SATURDAY, OCTOBER 15TH.

INTERNATIONAL EXHIBITION OF INVENTORS.—Central Hall, Westminster, S.W.1. 11 a.m. to 10 p.m. daily.

THURSDAY, OCTOBER 6TH.

BIRMINGHAM METALLURGICAL SOCIETY.—At the University, Edmund-street, Birmingham. Presidential Address, Mr. A. A. Jude. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Merchant Venturers' Technical College, Bristol. Presidential address, "Legislation and the Automobile Engineer," by Major C. G. Nevatt. 7 p.m.

ROYAL AERONAUTICAL SOCIETY.—At the Royal Society of Arts, John-street, Adelphi, W.C.2. "Air Navigation," by Captain N. MacMillan. 6.30 p.m.

FRIDAY, OCTOBER 7TH.

INSTITUTION OF CHEMICAL ENGINEERS.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, W.1. "Fluid Friction and its Relation to Heat Transfer," by Dr. C. M. White. 6 p.m.

INSTITUTION OF PRODUCTION ENGINEERS: LONDON SECTION.—In the Council Room, Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W.1. "Factory Lighting," by Mr. A. E. Iliffe. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W.1. "Cornwall as a Cradle of Science and Engineering," by Mr. S. J. Crispin. 7.30 p.m.

RAILWAY CLUB.—57, Fetter-lane, Fleet-street, E.C.4. "The Great North of Scotland Railway," by Mr. H. A. Vallance. 7.30 p.m.

SATURDAY, OCTOBER 8TH.

INSTITUTE OF BRITISH FUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. "Some Notes from Previous Lectures on Foundry Practice," by Mr. E. Longdon. 6.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: SOUTH-EASTERN DISTRICT, JUNIOR SECTION.—Assemble at Municipal Offices, Sutton, Surrey. 2.15 p.m.

MONDAY, OCTOBER 10TH.

ENGINEERS' GERMAN CIRCLE (DEUTSCHER INGENIEURZIRKEL IN LONDON).—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, S.W.1. "Der Benson-Hochdruckkessel (225 atmos.) als Land-und Schiffskessel, Ausführungen und Erfahrungen" ("The Benson High-pressure Boiler, 3200 lb. per Square Inch, as Land and Marine Boiler, Construction and Results"). Illustrated with lantern slides, by Diplom-Ingenieur F. Ohlmüller, of Siemens-Schuckertwerke. 5.15 p.m. for 6 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Chairman's Address, Professor Robert Hay. 7.30 p.m.

TUESDAY, OCTOBER 11TH.

INSTITUTE OF MARINE ENGINEERS.—The Minories, E.C.3. "The High-speed Marine Diesel Engine," by A. F. Evans. 6 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. Chairman's Address, Mr. A. Logan. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—In the Rooms of the Y.M.C.A., Swansea. "Refractory Materials and the Non-ferrous Industries," by Mr. A. B. Searle. 6.15 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. Presidential Address, by Mr. Archibald Gilchrist. Paper, "The M and C System of Time Study and Rate Fixing," by Mr. Sam Mavor. 7.30 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS: ASSOCIATE MEMBERS AND GRADUATES' SECTION.—At the Borough Polytechnic, Borough-road, Southwark, S.E.1. "Some Features of the Manufacture of Malleable Iron Fittings and Cast Iron Radiators," by Mr. C. E. Green. 7 p.m.

INSTITUTION OF PRODUCTION ENGINEERS: EASTERN COUNTIES SECTION.—Library Lecture Hall, Ipswich. "Small Lot Production," by Mr. W. Buchanan. 7.30 p.m.

LINCOLNSHIRE IRON AND STEEL INSTITUTE.—Central Schools, Cole-street, Scunthorpe, Lincs. "Blast-furnace Engineering," by Mr. W. R. Brown; "Improvements in the Greenawalt Sintering Apparatus," by Mr. J. Tornblad; "Generation of Steam from Blast-furnace Gas," by Mr. A. F. Webber. 7.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. Joint meeting with the Iron and Steel Institute. "Fatigue Resistance of Unmachined Forged Steel," by Mr. G. A. Hankins and Mr. M. L. Becker; "Spectroscopic Estimation of Nickel, Manganese and Chromium in Steels," by Mr. Twyman and Mr. A. Harvey; "Scale Removal by Acid Pickling," by Mr. A. B. Winterbottom and J. P. Reed. 7.30 p.m.

WEDNESDAY, OCTOBER 12TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, S.W.1. "Steel Frames for Diesel Engines," by Mr. C. H. Stevens, 3 p.m.

INSTITUTION OF PRODUCTION ENGINEERS: COVENTRY SECTION.—Ball Room, King's Head Hotel, Coventry. "Design and Manufacture of Welded Steel Fabrications," by Mr. H. W. Hawkins. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS: LUTON, BEDFORD AND DISTRICT SECTION.—Royal Hotel, Luton. "Organisation of Production Engineering," by Mr. B. C. Jenkins. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS: NORTH-WESTERN BRANCH.—The College of Technology, Manchester. Film on "Oxy-acetylene Welding." Discussion. 2.30 p.m.

THURSDAY, OCTOBER 13TH.

INSTITUTE OF MARINE ENGINEERS: JUNIOR SECTION.—The Minories, E.C.3. "Some Aspects of Modern Steam Turbine Design and Construction," by Mr. J. D. Pearson. 7 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the University, Edmund-street, Birmingham. "Symposium on Hardness Testing." 7 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—In the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W.1. Chairman's Address, Mr. S. L. Archbutt. 7.30 p.m.

THURSDAY TO SATURDAY, OCTOBER 13TH TO 22ND.

INTERNATIONAL MOTOR CAR AND MOTOR BOAT EXHIBITION.—Olympia, Kensington, W.

FRIDAY, OCTOBER 14TH.

CHEMICAL ENGINEERING GROUP.—At Burlington House, Piccadilly, W.1. "Colloidal or Coal-oil Fuel," by Professor J. S. S. Brame. 8 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. Chairman's Address, "Annealing." Captain F. Orme. 7.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—Grosvenor Restaurant, Glasgow. "James Watt" dinner.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W.1. Informal meeting. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W.1. Chairman's Address, Mr. J. Foster Petrie. 7.30 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. C. A. BISHOP has relinquished the appointment of general manager of Davy Brothers, Ltd., Sheffield, and is taking up the appointment of the company's London representative.

MR. H. BLAKE THOMAS, M.I. Mech. E., who prior to going abroad was contractors' engineer with the firms of W. Hill and Co. and E. R. Lester, and in recent years general manager of the Beni Felkai Mines, has joined the board of the Lester Construction Company, Ltd., public works contractors, 68, Victoria-street, S.W.1.

THE WOODALL DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1930), Ltd., informs us that Mr. F. B. Richards has been appointed chairman of that company. A committee of management has also been formed and consists of the chairman, Mr. F. B. Richards; the managing director, Mr. G. J. Jackson, who will continue to be responsible for the company's constructional work; and the technical director, Dr. E. W. Smith, who will have charge of the design, development and operation sides of the business. Mr. F. B. Richards has also been elected chairman of Woodall-Duckham (1920), Ltd.

CONTRACTS.

RICHARD DUNSTON, Ltd., of Thorne, Yorkshire, has received an order for three large grain-carrying lighters.

JOHN I. THORNYCROFT AND CO., Ltd., have received an order for an 850-ton yacht for a British owner residing abroad.

HENRY SCARR, Ltd., Hessle, near Hull, has begun work on a large grain-carrying lighter for Hull owners. The firm has also a number of repair jobs in hand.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., has received an order from the Douglas (I.O.M.) Corporation Electricity Works, for one 1500 kW Brush-Ljungstrom turbo-generator set complete with condenser, &c.

TALBOT STEAD TUBE COMPANY, Ltd., is supplying the boiler and flue tubes and the tubes for the superheater elements for the ten locomotives being built to the order of H.E.H. the Nizam's State Railway by the North British Locomotive Company and the Vulcan Foundry Company, Ltd.

THE CHEMICAL AND INSULATING COMPANY, Ltd., of Darlington, has secured contracts for the whole of the insulation required in the new power station at Rotterdam and for all steam and heating pipe covering required for the extensions at Leeds University, and at the Witton works of the General Electric Company, Ltd.

ENGINEERING PRACTICE.—We have received from George Newnes, Ltd., the first part of a new weekly series—forty-eight parts at 1s. each—publication of which has just begun. The purpose of this series is to instruct readers in the use of tools and workshop appliances of all kinds and in the crafts of the mechanic, erector, &c. The idea is a good one and as the part before us is liberally illustrated it should help those not already experienced to understand a great deal of workshop practice. A novel article in the present number is a description with illustrations of the installation of a small stationary petrol engine. In another article, which discusses surface plates and their use, we notice that an over-zealous grammarian speaks of "deadly flat surfaces." The first article, by J. P. Stephenson, on the "Study of Gravity Through Falling Bodies," is made interesting by the nature of the apparatus employed and the reproduction of cinema films.